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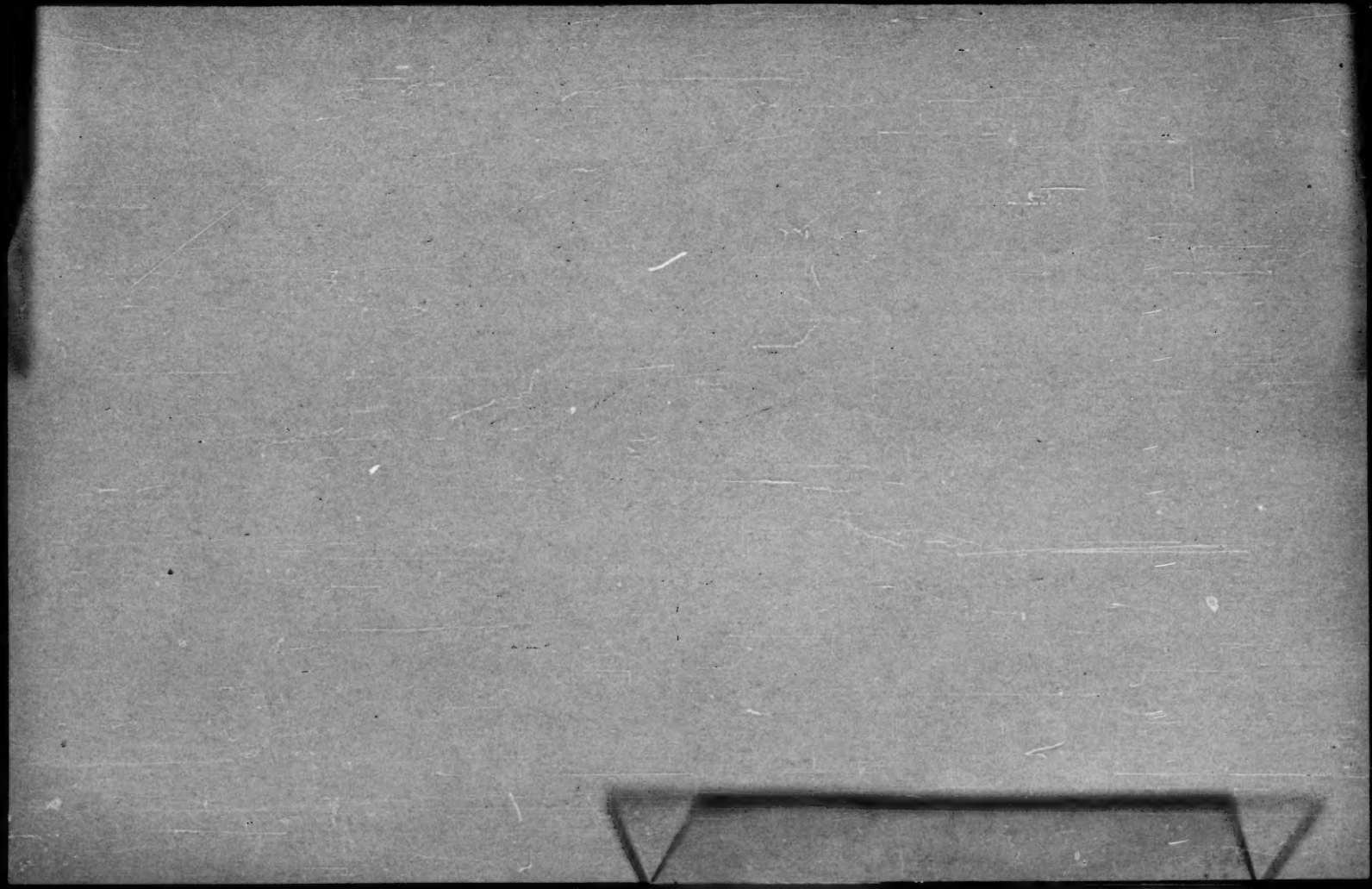

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A Determination of Fundamental Concepts of Healthful Living and Their Relative Importance for General Education at the Secondary-School Level

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DURING the past decade of progress in American education, health instruction, either as a separate course or as specific parts of other courses, has steadily risen to a place of prominence in the secondary-school curriculum. With the comparatively rapid growth of health instructional programs in the secondary schools of the nation, the problem of determining course content has become more and more difficult. Since health instruction provides a relatively new area in the total secondary-school curriculum, objective evidence at this time is lacking with regard to the relative importance of the various portions of subjectmatter commonly associated with courses in personal and community hygiene and healthful living.

The Problem

Statement of the problem. It is the purpose of this study to determine objectively, and rank in the order of their importance, those fundamental concepts of healthful living which are of functional value in contributing to the general education of secondary-school pupils.

Importance of the study. An increasing awareness among educators of the dire need for health instruction in the public schools of the nation is evident in the added emphasis upon this area of the curriculum in many of our schools today. Although the movement, as with most educational trends, has been somewhat slow in beginning, it nevertheless may be safely stated that health instruction will continue to grow as a phase of education which is truly functional in its objectives. A number of states, including New York, Pennsylvania, and Oregon among others, have already prepared syllabi

containing units in health instruction and have included these units as a part of the total educational program in their schools.

As research and crystallization of our thinking in health education progresses, it is to be expected that other states, cities, and communities will recognize the need for health instruction in the schools at all grade levels and will act accordingly in revising their curricula and in selecting teaching personnel.

It is clear that the need for health instruction, in all the schools and at all grade levels, is vital to the total education of our young citizens. Many schools have made a fine beginning in teaching health at either the elementary or secondary grade levels. However, one of the most pressing problems associated with the inclusion of health instruction in the curriculum is the difficulty of determining just what should be taught. This is particularly important at the secondary level which represents, in effect, the pupil's last opportunity to gain those knowledges and skills which must carry him through life. The significance of this problem has been strongly emphasized by Chenoweth and Selkirk (8) in the following discussion:

> "A new examination of the facts now taught needs to be made in order to see what is omitted that should be taught, to relegate to their proper places those things that are of only minor importance, and to eliminate the things that are not true. Texts in health sometimes contain errors that are copied and quoted over and over again in books by other authors. Texts should be more critically examined by experts before they are adopted. Some of the things now taught do not have a value in keeping with the prominent place they occupy in teaching. One is inclined to suspect that some things are stressed because of the ease of teaching them and the difficulty of teaching other facts of greater importance.

Furthermore, Billett[1] emphatically points out the need for "the identification of the concepts and skills which are essential to, or consistent with, successful, happy and socially desirable behavior in a democracy"[2] in order to insure the most effective teaching at the elementary- and secondary-school levels.

If a phase of general education is to command a place of prominence and importance in the total educational plan at the secondary level, it is necessary that certain basic and fundamental concepts be determined and established to provide the core for the instructional plan. In the light of modern trends in education, it is of paramount importance that these fundamental concepts in healthful living be directly related to the life experiences, both present and future, of the school child.

The unquestioned value of principles, or fundamental concepts, to the instructional program in the schools has been clearly illustrated in the field of science. The National Society of Education[3] cites the principles of Mar-

[1] Roy O. Billett, *Fundamentals of Secondary-School Teaching*. Boston: Houghton Mifflin Company, 1940. p. 150.

[2] *Ibid.* p. 369.

[3] "A Program for Teaching Science," *Forty-Sixth Year-book of the National Society of Education*. Part I. Chicago: The University of Chicago Press, 1947.

tin[4] and Wise[5] in its recommendations for the teaching of science in the nation's schools. Science teachers throughout the country have been greatly benefited by the principles determined through these two studies. This research has marked one of the most significant advances in science education of the past century and points the way toward similar investigations in other areas of the curriculum.

Definitions of the Terms Used

Health. Throughout the report of this investigation, the term "health" shall be interpreted as indicating "that complete fitness of body, soundness of mind, and wholesomeness of emotions" which make possible the highest quality of effective living and of service.[6]

Health instruction. The term "health instruction," as used in this discussion, shall be interpreted as meaning all those teaching procedures, both incidental and direct, which are utilized in the development of health concepts and skills in addition to the concomitant attitudes, habits, and practices.

Concept. The term "concept," as used throughout this report, shall be interpreted as indicating "an idea or expression representing the common element or attribute of a group or class"[7] which is set forth in a comprehensive and medically valid generalization.

Major concept. A statement is considered to be a "major concept" of healthful living if it is a comprehensive generalization which includes in scope the widest possible range of facts within the area with which it was directly concerned, and if it is consistent with current accepted medicaf knowledge and research.

Minor concept. A statement is considered to be a "minor concept" of healthful living if it is a generalization which includes in scope a limited range of facts within the area with which it is directly concerned, and if it is consistent with current accepted medical knowledge and research.

Secondary-school level. Throughout the discussion of this investigation, the term "secondary-school level" refers to Grades IX through XII inclusive, which typifies the "regular" and most often encountered type of vertical organization of secondary schools at the present time.[8]

General education. The term "general education" in this study shall be interpreted as meaning "that portion of the training, both foundational

[4] William Edgar Martin. *A Determination of the Principles of the Biological Sciences of Importance for General Education.* Doctor's dissertation. Ann Arbor: University of Michigan, 1944.

[5] H. E. Wise, "A Determination of the Relative Importance of Principles of Physical Science for General Education," *Science Education* **25:** December 1941.

[6] C. E. Turner. *School Health and Health Education.* St. Louis: The C. V. Mosby Company, 1947. p. 24.

[7] Carter V. Good. *Dictionary of Education.* New York: McGraw-Hill Book Company, Inc. 1945.

[8] Roy O. Billett. *Fundamentals of Secondary-School Teaching.* Boston: Houghton Mifflin Company, 1940. p. 15–17.

and functional, which is of general need, whatever be one's occupation or station in life."[9]

Review of the Literature

The research literature offers comparatively little evidence of previous study concerned specifically with the determination, in an objective manner, of fundamental concepts of healthful living and their relative importance for general education at the secondary level.

A brief resume of those investigations which are concerned with related problems is presented here.

In 1926, Lerrigo[10] analyzed 24 sources for health problems which might afford a foundation for the curriculum in health instruction. Frequency of appearance of problems in these sources was interpreted as indicating the importance of the various groupings of health problems. It would seem illogical to mistake frequency of mention for true importance of health problems with respect to the needs of youth and adults.

Strang[11] in her study to determine course content in health instruction, tabulated topics according to frequency of mention in selected courses and textbooks in health. The study concluded that, from the topics determined, selection of meaningful content could be made on the following bases: (a) the teacher's judgment of the significance of certain topics for a particular class; (b) health deficiencies uncovered in medical examinations; (c) health-habit questionnaires answered by pupils; (d) health knowledge tests for pupils; (e) health status and problem questionnaires answered by a representative group of adults in the community. The validity of any health questionnaires of the types cited are open to question concerning their utilization as a basis for course content. In addition, the results of the health knowledge tests are only as valid, for the purpose of setting the curriculum, as are the test items.

Cairns[12] analyzed the major causes of mortality and morbidity and associated items of health instruction with these causes. On the basis of these statistical data, the investigator concluded that the following areas of health knowledge should be taught in order to prevent and reduce the number of deaths and illnesses: (a) structure and functions of the parts of the body; (b) epidemiology; (c) personal hygiene; (d) mental and physical defects; (e) race hygiene, including heredity and eugenics, maternal hygiene, and infant care; (f) organic welfare, including both mental and physical welfare; and (g) accident prevention. The most obvious criticism of a study of this type is that health, according to the most comprehensive

[9] Franklin Bobbitt. *How To Make a Curriculum*. Boston: Houghton Mifflin Company, 1924. p. 66.

[10] Marion W. Lerrigo. *Health Problems Sources*. New York: Bureau of Publications, Teachers College, Columbia University, 1926. 151 p.

[11] Ruth Strang. *Subject-Matter in Health Education*. New York: Bureau of Publications, Teachers College, Columbia University, 1927. 108 p.

[12] Laura Cairns, *A Scientific Basis for Health Instruction in Public Schools* (University of California Publications in Education, Vol. 11, No. 5, 1929) p. 339–434.

definition, is not merely the absence of death, disease, or impairment but, in addition, implies the functioning of the total organisms at the highest possible level of efficiency and well-being. Nevertheless, the tabulation of these data provides an important part of the total basis for the selection of subjectmatter content in health instruction.

Oberteuffer[13] conducted a study with college students in which records of questions on health matters, asked over a period of five-and-a-half years by 2400 students, were painstakingly recorded, assembled, and organized into topic areas and sub-divisions of these areas. This study, although based upon the shifting foundations of student knowledge, curiosity, and educational background, affords an excellent and comprehensive source for shaping the health curriculum at the college level.

Caldwell and Lundeen[14] have contributed to the literature in their investigation of popular superstitions, fallacies, and unfounded beliefs concerning health. Their study offers scientific proof that exposes the half-truths of health which are blindly accepted by many children and adults. Although this material provides only that portion of the total health course which is negative in nature, it still has much to offer the curriculum-maker in health instruction.

Logical Analysis

In order to determine the fundamental concepts of healthful living which are of importance for general education at the secondary level, the problem was divided into two major sections, *the inductive phase* and *the deductive phase.* These two phases were considered separately and in the order named.

The inductive phase. The purpose of this portion of the study was to obtain a list of the fundamental concepts of healthful living. This phase was divided into two subproblems which were approached in the following order:

Sub-Problem 1. The purpose of this sub-problem was to select and determine the fundamental concepts of healthful living as they occur in 10 textbooks in health designed for use at the secondary level.

Sub-Problem 2. The purpose of this sub-problem was to select and determine the fundamental concepts of healthful living occurring in 36 issues of the periodical *Hygeia* from May of 1945 to April of 1948. [*Hygeia* is now *Today's Health.*]

The deductive phase. The purpose of the deductive phase of the study was to determine, from the list secured by the inductive phase, the relative importance of each fundamental concept in terms of its suitability as a unit, or component part of a unit, of health instruction in a program of general education at the secondary level.

[13] Delbert Oberteuffer, *Personal Hygiene for College Students.* New York: Bureau of Publications, Teachers College, Columbia University, 1930. 121 p.

[14] O. W. Caldwell and G. E. Lundeen. *Experimental Study of Superstitions and Other Unfounded Beliefs as Related to Certain Units of General Science.* New York: Bureau of Publications, Teachers College, Columbia University, 1932. 138 p.

Sub-Problem 1. This sub-problem was concerned with the classification of each fundamental concept, according to the judgment of selected subject-matter experts, supervisors of health instruction, and master teachers of health, as either a major or a minor fundamental concept.

Sub-Problem 2. The purpose of this sub-problem was to determine the relative importance of each fundamental concept based upon the numerical ratings assigned by the subjectmatter experts, supervisors of health instruction, and master teachers of health.

Sub-Problem 3. The purpose of this final portion of the investigation was to rank both the major and the minor fundamental concepts in the order of their respective importance for the purpose of general education at the secondary level.

Research Procedure

The methods and techniques utilized in the solution of the problem are presented below in their sequential order.

The inductive phase. In order to obtain a valid list of fundamental concepts of healthful living, it was first necessary to survey a vast number of materials which might provide these concepts. There are many sources from which the secondary-school pupil might derive health knowledge either in the school situation or in an informal manner outside of the school environment. After due consideration and study on the part of the investigators, it was decided that textbooks, written for use at the secondary level, and the magazine *Hygeia* afforded the most authoritative, up-to-date, reliable and comprehensive sources for fundamental concepts of health and healthful living. These source materials, although written for the lay reader, provide a body of knowledge which may be considered reliable from the standpoint of recent developments in medicine and hygiene.

Sub-Problem 1. The investigators made a careful page-by-page analysis of each of the 10 selected health textbooks and considered all statements in the light of the following criteria of a fundamental concept of healthful living:

For a statement to be a fundamental concept it must be

a. A comprehensive generalization presented in one or more declarative sentences which includes in scope the widest possible range of facts within the area with which it is directly concerned. The facts summarized in this generalization must indicate objects and/or events and the relationships between them.
b. Scientifically true. To meet this criterion, it must be consistent with current and accepted medical knowledge and research.

Each generalization which satisfied the criteria was written on a file card along with the source reference. The cards for each text were kept in separate files and in sequential page order. If there was doubt as to whether a generalization fulfilled the criteria, it was included as a fundamental concept subject to later reconsideration.

The 10 health texts which were selected as sources for this part of the investigation are cited as follows:

BURKARD, WILLIAM E., CHAMBERS, RAYMOND L., AND MARONEY, FREDERICK W. *Health and Human Welfare.* Chicago: Lyons and Carnahan, 1944. 640 p.

CLEMENSEN, JESSIE WILLIAMS, AND LAPORTE, WILLIAM RALPH, *Your Health and Safety.* New York: Harcourt, Brace and Company, Inc., 1946. 592 p.

CRISP, KATHERINE BRUDERLIN, *Health for You.* Chicago: J. B. Lippincott Company, 1946. 611 p.

FISHBEIN, MORRIS, AND IRWIN, LESLIE W., *Health and First Aid.* Chicago: Lyons and Carnahan, 1944. 372 p.

GOLDBERGER, I. H., AND HALLOCK GRACE T., *Health and Physical Fitness.* Boston: Ginn and Company, 1946. 596 p.

MEREDITH, FLORENCE L., *Health and Fitness.* Boston: D. C. Heath and Company, 1946. 325 p.

PROSSER, C. A., AND ANDERSON, WALTER A., *A Health Program.* Bloomington, Illinois: McKnight and McKnight, 1936. 94 p.

TURNER, C. E., AND MCHOSE, ELIZABETH, *Effective Living.* St. Louis: The C. V. Mosby Company, 1946. 432 p.

WILLIAMS, JESSE FEIRING, *Healthful Living.* New York: The Macmillan Company, 1947. 607 p.

WILSON, CHARLES C.; BRACKEN, JOHN L.; AND ALMACK, JOHN C., *Life and Health,* Indianapolis: The Bobbs-Merrill Company, 1945. 547 p.

Sub-Problem 2. Thirty-six issues of *Hygeia,* from May of 1945 to April of 1948, were read and analyzed for statements of generalizations of healthful living. The same procedure used in attacking sub-problem 1 was employed here with regard to the analysis, selection, and recording of fundamental concepts.

All of the tentative fundamental concepts selected and determined from the analyses of sub-problems 1 and 2 were then assigned to topic areas, or logical organization of subjectmatter. These areas were set up arbitrarily by the investigators and served only to facilitate handling the large number of derived concepts. Each of these areas, 55 in all, were then studied and analyzed in order to combine related generalizations, eliminate duplications, and improve the wording wherever necessary. Similar and related generalizations were combined, or grouped together, by the process of telescoping which is recognized by Charters[15] as an effective method in handling such data.

A resultant list of 736 fundamental concepts of health were obtained by the methods and procedures described in sub-problems 1 and 2 of the inductive phase of the study. Each concept on this list was reconsidered by the experimenter in the light of the criteria established for the determination of fundamental concepts of health and healthful living.

The deductive phase. For the deductive phase of the study, it was decided to select a group which represented subjectmatter specialist, supervisors of

[15] W. W. Charters and Douglas Waples, *The Commonwealth Teacher-Training Study.* Chicago: The University of Chicago Press, 1929. p. 75.

health instructional programs at the secondary level, and master teachers of health in the secondary schools. It was felt that a group of this type was best qualified to determine the relative importance of fundamental concepts for general education at the secondary level. These selected persons provided the astute judgment of the frontier thinker, the administrator and curriculum builder, and the classroom teacher. All three of these types are of vital importance to a study of this nature if valid and reliable results are to be obtained.

In order to establish reliability of classifications and ratings made by these health educators, six people were selected and divided into two separate juries. Each jury was made up of one subjectmatter expert, one supervisor, and one teacher. These juries were made up of the following persons:

JURY 1

LESLIE W. IRVIN, *professor of health education, School of Education, Boston University.*

GRACE KEENAN *supervisor and teacher of health, Brockton Public Schools, Brockton, Massachusetts.*

EDWARD J. WALL, *director of health education and safety education, Boston Public Schools, Boston Massachusetts.*

JURY 2

BERYL J. ROBERTS, *director of health education, Massachusetts Tuberculosis League, Boston, Massachusetts.*

ORREN B. MCKNIGHT, *director of health and physical education, Haverhill Public Schools, Haverhill, Massachusetts.*

RALPH C. BEAN, *head of the science department and coordinator of health education, Girls' High School, Boston, Massachusetts.*

The judgments and evaluations of these jurors served as the basis for determining the relative importance of the fundamental concepts for the purpose of general education at the secondary-school level.

Sub-Problem 1. Each jury met separately with the investigators for the purpose of classifying concepts as major or minor. Six meetings were held for each jury with from three to four hours devoted to each conference. The 736 fundamental concepts of the list secured by the inductive phase of the study were analyzed and discussed, one by one, and classified as major or minor concepts depending upon the extent of their scope and comprehensive nature. For example, the statement "narcotics slow down nerve action while stimulants accelerate nerve activity" was considered to be a major concept; the statement "relief from fatigue as a result of smoking comes from a temporary stimulation of the adrenal glands" was judged a minor concept. This classification of generalizations as major or minor was completely independent of their importance for general education and was based solely upon comprehensiveness.

At the same time, each of the 736 concepts were checked by the jurors against the previously established criteria for a fundamental concept. Generalizations which did not, in the judgment of the jury, qualify as a

true fundamental concept according to the criteria were eliminated from the list.

Concepts which the jury thought to be duplications or close similarities were combined or the concept which was most effectively worded was retained and the other eliminated. Each jury reworded any concepts which, in their opinion, required such rewording in order to improve clarity and comprehensiveness.

Those concepts which were classified as major by one jury and minor by the other were reconsidered and an individual vote was taken from each of the six jurors. In this manner, all concepts were ultimately classed as being major or minor.

Sub-Problem 2. The final list of fundamental concepts arrived at through the solution of sub-problem 1 of the deductive phase, was divided into two separate lists—one containing major concepts and the other minor concepts. These final lists were then submitted to each of the six jurors for their individual evaluation. The jurors were instructed to rate each concept in terms of its suitability for use as a unit, or component part of a unit, of health instruction and in terms of its contribution to general education at the secondary level. Numerical ratings were assigned in accordance with the following rating scale:

1.....Not at all suited
2.....Poorly suited
3.....Neither well- nor poorly suited
4.....Well-suited
5.....Ideally suited

For statistical purposes, the numerical ratings of each of the two juries were considered separately and independently. Thus, two sets of ratings were available, one which included the evaluation of Jury 1 and another which embodied the ratings of Jury 2.

The sums of the three jurors' ratings, of both Jury 1 and Jury 2, on each individual concept was considered for the purpose of determining the extent of agreements, or the degree of unanimity, between the ratings of the two juries.

Thus, each concept was assigned two separate scores or total ratings, one representing the evaluation of Jury 1 and the other representing the evaluation of Jury 2.

On the basis of these two separate total scores for all concepts, the reliability of the evaluations of the two juries was determined by computing the coefficient of correlation by the Pearson product-moment method.

The coefficient of correlation between the ratings of Jury 1 and Jury 2 on the major concepts was .66 P. E. — .02. The coefficient of correlation between the evaluations of Jury 1 and Jury 2 on the minor concepts was .63 P. E. — .02.

These coefficients may be said to "show a marked relational trend"[16]

[16] Herbert Sorenson, *Statistics for Students of Psychology and Education*. New York: McGraw-Hill Book Company, Inc. 1936. p. 276.

and would seem to indicate a reasonably close agreement in the evaluations of the two juries and also suggest a relatively high degree of reliability for the jury technique.

Sub-Problem 3. In order to provide an objective basis for the final ranking of both major and minor concepts, in the descending order of their importance for general education at the secondary level, the numerical ratings of all six jurors were grouped together. The modal value for each of the concepts, in both the major and minor lists, was determined from the six numerical ratings. By this method, each concept was assigned its mode value, a discrete number from one to five inclusive.

On the basis of its mode rating, each concept was ranked in the order of its importance. Inasmuch as the mode was used to indicate the relative value of each concept, all concepts fell within some one of the five rank areas. Thus, a concept having a modal score of five would rank in the upper one-fifth of all the concepts in that particular list; a concept with a mode of three would be ranked in the middle one-fifth, and so on.

Within each of the five rank areas of the list, those concepts which were logically related with regard to subjectmatter topics were grouped together to follow one another in sequential order. This was done to facilitate the selection of concepts by teachers in constructing units, or parts of units, concerned with related health topics.

The range was determined for each group of ratings on each concept in order to provide information regarding the degree of unanimity of ratings. However, this range and the distribution of scores for each concept are not included in the tables of this report since it is felt that the coefficients of correlation cited above afford a general indication of the degree of unanimity of the jurors.

The major concepts and the minor concepts were ranked separately and included in two individual tables. Because of space limitations, only the table of major concepts, which represents the core of the results of the study, is presented.

Summary and Conclusions

This portion of the study presents a summary of the nature and scope of the problem, the logical organization and methods of procedure, the conclusions which may be drawn on the basis of the data, the implications of these conclusions, and suggestions for future investigation.

Summary of the study. The major purpose of this study is to determine the fundamental concepts of healthful living which are of importance for general education at the secondary level, and to rank these concepts in the descending order of their relative importance. The scope of the investigation and the application and implications of the findings are limited to those grades, from nine through 12 inclusive, which make up the traditional type of public secondary school in this country.

The problem was logically organized into two major parts, the inductive phase and the deductive phase. The problem of the inductive phase in-

volved the selection and determination of fundamental concepts of healthful living by an analysis of 10 textbooks in health, written for secondary-school pupils, and 36 recent issues of the health periodical *Hygeia*.

The deductive phase of the study was concerned with the classification, as major or minor, of each concept derived from the inductive phase, in addition to the rating of these concepts individually in terms of their importance for general education at the secondary level. This classification and evaluation of the fundamental concepts was done by two juries composed of subjectmatter specialists, supervisors of health instruction in the schools, and master teachers of healthful living at the secondary level.

On the basis of these classifications and ratings by the juries, the resultant list of fundamental concepts was divided into two separate lists, one of which contained the major concepts and the other the minor concepts. Within these two lists the concepts were ranked in the descending order of their importance, according to modal values of their ratings, for general education.

Conclusions. Within the limitations of the sources of material and the methods of handling these data, the following conclusions may be considered as being justifiable on the basis of the results of this investigation:

1. The major list of 251 fundamental concepts is made up of those concepts of which a comprehension is necessary for optimal individual and communal healthful living.
2. The minor list of 279 fundamental concepts is composed of those concepts which contribute to an understanding of the major concepts.
3. The fundamental concepts contained in both lists may be considered scientifically true or in accord with the current accepted medical knowledge and research.
4. From the evaluation of the concepts by the two juries it would seem that those major and minor fundamental concepts which have been assigned a modal value of three or higher are suitable as units, or component parts of units, of health instruction in the secondary schools.
5. The high coefficients of rank correlation between the rankings of the concepts by the two juries indicate a sufficiently high reliability for the jury technique of evaluation to justify its use in a study of this nature.

Implications of the conclusions. From a survey of the available published research directly related to the determination of course content in health instruction, it would seem significant that there are no previous studies which set forth basic concepts of healthful living for the secondary level founded upon objective methods of research.

The fundamental concepts of healthful living determined by this study may well prove valuable to teachers of health in the secondary schools; to persons engaged in the training of teachers of health and physical education for the secondary level; to high school health councils or committees concerned with the building or revision of a health course; to persons conducting research in the secondary-school curriculum; to the authors of textbooks, workbooks, and other health teaching materials for secondary pupils; and to the producers of health instructional films for high school usage.

For the groups described above, these lists of major and minor concepts may well offer some objective index of the relative importance of the various concepts for general education, and, at the same time, indicate to some extent the amount of time and emphasis which should be given to these concepts.

It must be recognized that the teaching of all of these fundamental concepts presents somewhat of an impossible task to the teacher in the average secondary school, even if only those concepts having a modal value of three or higher are considered. It should therefore be pointed out here that the teacher will, in most instances, select those concepts within the upper categories of the lists which fit the needs of his particular situation.

Suggestions for further investigation. During the consideration and study of this problem, several closely related problems have become evident as being worthy of further research. The writers feel that the following problems are of sufficient importance to justify additional study:

1. An investigation which would attempt to evaluate the concepts arrived at through this study in the light of applicatory activities of daily living recorded on a random sampling of the population.
2. A study to determine the relationship between these fundamental concepts, and their comprehension, and the possible avoidance or prevention of defects, diseases, and impairments, as reported in the National Health Survey or a more recent representative survey.
3. A similar study to determine and evaluate fundamental concepts of healthful living for health instruction in elementary schools and colleges.

Appendix

The major fundamental concepts. Those concepts which were classified as major according to the procedure previously described are presented in ranked order in Table 1 of the following pages.

The reader should be aware of the fact that the major concepts are not so classified because they are more important than the minor concepts, but rather because they are wider in scope and comprehensiveness. As might be expected, the ramifications of a major concept are more extensive in their universality than are those of a minor concept. However, it is well for the teacher to keep in mind that the classification is based upon scope rather than importance for general education. The relative importance of each concept is readily apparent by its position on the list.

Time allotment, availability of study materials, background of the pupils, health education training of the teacher, and numerous other factors will necessitate differences in the selection of concepts for various school situations.

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TABLE 1

Rank	*Major fundamental concepts*	*Modal value*
1.	The health of the individual is protected first, by proper personal hygiene; and second, by the activities of organized government in disease prevention.	5
2.	The work of health departments in general consists of medical services, control of health conditions, and educational and publicity services.	5
3.	The United States Public Health Service is concerned with international quarantine, medical work for certain groups, domestic quarantine and the health aspects of interstate commerce, administration of funds for health work to the states, and maintenance of National Health Institute for extensive medical research.	5
4.	The work of state departments of public health usually includes the establishment of standards for community health, conducting investigations, maintaining laboratories, maintaining hospitals, conducting statewide programs for better health, rendering first aid, and carrying on health education programs.	5

Rank	Major fundamental concepts	Modal value
5.	City health departments work to protect and maintain the health of of individuals by providing medical, dental, and nursing programs, clinics for diagnostic purposes, prevention and control of communicable diseases, maternal and child health programs, laboratory examinations, health education, vital statistics, control of food and water supply, and sewage and garbage disposal.	5
6.	The principal dangers of self-medication are, first, the medicine by giving temporary relief, may keep the person taking it from consulting a doctor for some serious condition which needs immediate medical attention; and second, the medicine may contain drugs to which a person is allergic, or which are dangerous or habit-forming.	5
7.	It is impossible to tell what medicine a person needs, if any, until a physician has determined the nature of the trouble.	5
8.	All the systems of the body are interdependent and the function of all systems is necessary to maintain life.	5
9.	The organs within the various systems perform specific functions in the maintenance of life.	5
10.	From its environment the body must receive food, water, and oxygen in order to insure growth and maintenance of every living body cell.	5
11.	The bodily functions of digestion, secretion, excretion, respiration, protective covering, contractility, irritability, support, distribution, and reproduction are necessary for life maintenance.	5
12.	The cell functions by taking in food, water, and air and giving off waste products, by carrying on digestion for the sustenance of life, and by reproducing its kind.	5
13.	Like all living organisms the human body is made of living material called protoplasm.	5
14.	A cell is the smallest unit of structure of which any living thing is composed.	5
15.	Through the process of mitosis new cells are formed to replace worn-out cells.	5
16.	The skeletal and muscular systems work closely together and function to bring about motion in different parts of the body, to give the body size and shape, and to protect delicate organs.	5
17.	Involuntary muscles function automatically, and they help to carry on vital processes.	5
18.	The voluntary muscles of the body are subject to conscious control.	5
19.	Development and maintenance of muscles in the best condition cannot be accomplished without adequate food, rest, and exercise.	5
20.	Muscle fatigue results when action is vigorous or prolonged and the blood is unable to remove lactic acid as rapidly as it is formed causing an accumulation of this substance in the cells.	5
21.	The oxygen needs of the body are in proportion to the amount and extent of muscular activity.	5
22.	The process of ossification requires that children have proper diet and exercise.	5
23.	Sketetal defects in structure and function may result from malnutrition, disease, or injury.	5
24.	Foot defects result from improperly fitting shoes, faulty habits in the use of the foot, weakened muscles due to illness or disuse, or hereditary causes.	5
25.	Poor posture may be caused by hereditary traits, improper diet, lack of rest and recreation, incorrectly designed furniture, poor muscle tone, mental and emotional tensions, bad habits of sitting, standing, and lying; and physical defects such as poor eyesight, loss of hearing, or bone defects.	5

Rank	Major fundamental concepts	Modal value
26.	Posture is important because it may materially affect the physical, mental, and social well-being of the individual.	5
27.	The functions of the circulatory system are: (1) the transfer of foods from the digestive system to the tissues, (2) the exchange of oxygen and carbon dioxide, (3) the carrying of waste products to the kidneys, (4) the transfer of endocrine secretions from the ductless glands to the places where they are to be used, (5) the regulation of the heat of the body, and (6) to aid in the development of immunity to disease.	5
28.	Through the circulatory system food and oxygen are carried to all parts of the body and waste products of the cells are removed.	5
29.	Blood flows through the kidneys in the renal circulation where wastes are removed for release from the body.	5
30.	Through the portal circulation the blood gives up some of its nutrients to the liver for storage and takes up waste materials.	5
31.	Through the systemic circulation the blood carries nutrients and oxygen to the extremities of the body and returns carbon dioxide and other waste products.	5
32.	Through the pulmonary circulation carbon dioxide and oxygen are exchanged in the lungs.	5
33.	The circulatory function is carried out by the heart, the blood, and the blood vessels, in addition to the lymphatic system.	5
34.	Tissue fluid, or lymph, circulating through the lymphatic vessels, takes up waste materials and bacteria and assists in providing food and oxygen for the cells.	5
35.	The heart is a hollow muscular organ which pumps the blood through the blood vessels from before birth until death.	5
36.	The heart rate is affected by the extent and degree of physical activity, age, sex, size of heart, and emotions.	5
37.	The function of the heart is to maintain life through its action in keeping the blood flowing steadily throughout the body.	5
38.	Heart disorders are frequently due to a lack of proper care in childhood and youth.	5
39.	Injury to the heart during or following an infectious disease usually is caused by the poisonous effect on the heart and blood vessels of toxins produced by the germs, and by the extra work required of the heart in helping the body to overcome the infection.	5
40.	Drugs which affect the heart are extremely powerful in their action and should be taken only under medical supervision.	5
41.	Anemia may be caused by a lack of red corpuscles, insufficient hemoglobin in red corpuscles, hemorrhage, acute and chronic infections, or certain organic diseases.	5
42.	The most important function of the erythrocytes, or red cells, of the blood is that of carrying oxygen from the lungs to the body cells and the transport of carbon dioxide from the cells to the lungs.	5
43.	Many of the general infections are accompanied by an increase in the number of white cells in the blood; thus, a high count of white cells indicates that infection exists somewhere in the body.	5
44.	The digestive processes change raw food materials, by chemical and mechanical action, into soluble simple substances which may be used by the cells of the body.	5
45.	Digestion is carried out by the organs making up the digestive tract, or alimentary canal, including the mouth, esophagus, stomach, small intestine, and the large intestine in addition to cooperating organs outside the digestive tract, including the salivary glands, pancreas, and the liver.	5

Rank	*Major fundamental concepts*	*Modal value*
46.	Digested foods are taken up by the process of absorption into the circulatory system for transportation to the cells.	5
47.	Digestion is affected by the type of food eaten, emotions, fatigue, strenuous exercise immediately before or after eating, and by the sight, odor, and taste of food.	5
48.	The body requires food to furnish energy for heat, movement, and thought; to help build body tissues for growth and repair; and to help in the chemical process of forming secretions necessary to regulate body functions and to protect health.	5
49.	Food is utitized by the body through the metabolic processes, including digestion, absorption, assimilation, oxidation, and excretion.	5
50.	The body requires, in addition to vitamins and minerals, carbohydrates and fats, for energy; proteins, for building, repair, and some energy; alkaline and acid residues, for keeping the reaction of the body fluids nearly neutral; for stimulating the intestines; water, for aiding in chemical changes, elimination, temperature regulation and other body processes.	5
51.	Dietary needs of the individual vary with differences in digestion and metabolism, age, sex, height and weight, area of body surface, activity, temperature of the environment, nature of clothing, and mental and physical health.	5
52.	Good nutrition results from eating all the essential food elements in the amounts required for growth, energy, and health.	5
53.	By proper food selection we may prevent or cure diseases and conditions caused by a lack of one or more essential food elements.	5
54.	A good natural complexion, good posture, firm muscles, and normal resistance to fatigue and infection are all dependent upon good nutrition.	5
55.	Dietetic fads and fallacies usually have no scientific basis for justification and are often detrimental to good nutrition.	5
56.	Large amounts of protein foods are needed particularly during childhood as growth and repair materials.	5
57.	Vitamins in the diet are essential to life and growth and normal functioning of the body.	5
58.	Insufficient vitamins in the diet may result in a lack of optimum health.	5
59.	Deficiency diseases are caused by a lack of vitamins.	5
60.	Proper amounts of bulky substances, or "roughage", in the diet stimulate intestinal muscles and thus aid in the elimination of waste from the large intestine.	5
61.	Heat and other forms of energy in the body are developed through the oxidation of digested food in the cells.	5
62.	Gaining weight may be accomplished by correcting physical defects, longer hours of sleep, a balanced program of exercise and relaxation, and the addition of more calories to the diet without increasing food bulk.	5
63.	A safe and effective method of reducing weight is through the proper control of the caloric intake in the diet.	5
64.	Underweight may be caused by malnutrition, illness, emotional stress, grandular disturbance, or a focal infection.	5
65.	The body continually eliminates wastes through the kidneys, skin, alimentary canal, and lungs.	5
66.	The liver stores materials, excretes wastes, and manufactures and secretes substances which aid in digestion and absorption.	5

Rank	*Major fundamental concepts*	*Modal value*
67.	The flow of perspiration helps to regulate body temperature and to help rid the body of wastes.	5
68.	The kidneys function in filtering out a large amount of water, urea, and other salts from the blood, and pass these materials, in the form of urine, to the bladder for elimination.	5
69.	Adequate intake of water helps in maintaining the proper functioning of the kidneys.	5
70.	The urinary system rids the body of its soluble nitrogenous waste products.	5
71.	Regular habits of elimination may be an important factor in the prevention of constipation.	5
72.	Constipation may result from a lack of vitamin B or cellulose in the diet, insufficient water intake, insufficient exercise, fatigue, emotional upset, or failure to heed the impulse of defecation.	5
73.	The intake of water, correct diet, exercise, good muscle tone in the abdominal walls, good mental health, and attention to nervous stimuli created by the presence of feces in the colon are all factors in maintaining regularity of bowel elimination.	5
74.	The use of laxatives, or cathartics, is an undesirable, artificial, and sometimes dangerous measure in dealing with constipation.	5
75.	Cooperation between the organs in the body is controlled by the nervous system and secretions of the endocrine glands.	5
76.	Endocrine secretions exert a profound influence on the appearance, body processes, and mental and emotional functions of individuals without themselves undergoing any change in form.	5
77.	Respiration consists of two processes: an exchange of oxygen and carbon dioxide between the lungs and the atmosphere, called external respiration; and a similar exchange between the blood and the tissues, called internal respiration.	5
78.	Any failure of the body to secure sufficient air may result in mental retardation, imperfect nutrition, and, in extreme cases, asphyxiation.	5
79.	Inspired air flowing over the nasal mucous membrane is warmed to body temperature, moistened, and freed of impurities.	5
80.	Habitual mouth breathing endangers health and may also seriously interfere with the normal development of the teeth and jaw bone.	5
81.	Respiratory diseases may result from nasal obstructions, environmental conditions, allergens, infections of various types, and certain chronic conditions.	5
82.	The common cold is an acute infection of the nose or throat caused by a filterable virus which may be prolonged and complicated by a secondary invasion of the micro-organisms.	5
83.	Prevention of colds depends upon proper diet, avoidance of infection, and general resistance of the body.	5
84.	The most dangerous after effect of a cold or an attack of influenza is is lowered body resistance to pneumonia and tuberculosis.	5
85.	The skin functions in protecting the body, in regulating body temperature, in providing sensations of pressure, pain, heat, cold, and in eliminating wastes.	5
86.	In addition to capillaries, lymph vessels, and nerves, the derma contains sebaceous glands, which secrete oil; sweat glands, which release perspiration; and hair follicles, or tiny tubes, from which hair grows.	5
87.	The health of the skin depends upon proper diet, adequate sleep, exercise, and sunshine, and upon keeping the skin clean and invigorated by frequent bathing.	5

Rank	Major fundamental concepts	Modal value
88.	The skin requires regular bathing to remove accumulated secretions, dirt, and bacteria from the openings of the many imbedded sweat glands and also to get rid of the scaly, dead epithelial cells which form on the surface.	5
89.	The sweat glands of the skin form perspiration by extracting water and small quantities of urea, salt, and other substances from the blood.	5
90.	Skin disorders are caused by abnormal pigmentation or outgrowths from the skin, reactions to pressure, infections of oil glands and hair follicles, fungus infections, allergens, animal parasites and other inflammations.	5
91.	All sensations are received through receptors, or endings of sensory neurons, in the sense organs.	5
92.	Circulation of the blood helps to keep the temperature of the body uniform.	5
93.	The act of seeing involves the eyes, the visible object, the light by which the object is made visible, and the brain which interprets what is seen.	5
94.	Professional persons of three types care for eye disorders: the oculist, or opthalmologist, who is trained to deal with all forms of eye disorders; the optometrist, who is trained to measure refractive errors and to prescribe glasses; and, the optician, who is a specialist in the grinding of lenses.	5
95.	Noninfectious eye disorders may be caused by eye-strain, faulty diet, accidental injury, exposure to strong sunlight or high winds, or by disease in some other part of the body.	5
96.	Conditions necessary for good hearing include an open ear canal, freedom of the drum membrane and bones of the middle ear to vibrate, freedom of the auditory tube to open, receptors in condition to receive stimuli, the nerve's ability to transmit impulses, and the ability of the hearing centers in the brain to register and interpret sound.	5
97.	The chief function of the teeth is to prepare foods by biting, grinding, and cutting, for the process of digestion.	5
98.	Tooth decay may be caused by a variety of factors, including heredity, diet, occlusion, mineral content of water, an excess of certain bacteria in the saliva, and neglected oral hygiene.	5
99.	Control of dental decay involves good nutrition in early life, daily cleansing, and periodic inspection by a dentist with cleaning and repair if necessary.	5
100.	The diet of the mother before childbirth and of the growing child is an important factor in the development of sound teeth.	5
101.	The nervous system creates mental activity and controls and regulates the action of the muscles, organs, and blood vessels.	5
102.	The brain links all sensory impulses together, gives meaning to them, and causes the individual to act accordingly.	5
103.	Narcotics slow down nerve action while stimulants accelerate nerve activity.	5
104.	The primary danger present in the use of narcotics, or drugs, is their habit-forming power.	5
105.	The habitual use of alcohol tends to reduce the consumption of foods with the result that the body fails to obtain adequate nutrition.	5
106.	Caffeine, usually taken in coffee, tea, and some soft drinks, is a nerve and heart stimulant in addition to increasing activity of the kidneys.	5

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107.	Personality is a summation of a person's physical, mental, and emotional characteristics.	5
108.	It is within the power of individuals to stimulate desirable emotions and to curb undesirable ones.	5
109.	Physical defects may affect an individual's mental health, just as as mental defects may result in certain physical manifestations.	5
110.	Diseases are caused by germs, or micro-organisms, which include many kinds of bacteria, viruses, minute animals, molds, and yeasts.	5
111.	An infected person may transmit germs from his skin, from any of the body openings, or in any of the excretions or secretions from the body.	5
112.	Seriousness of infection depends upon the kind, number, and virulence of germs in addition to the kind, amount, and resistance of tissues involved.	5
113.	Disease germs may enter the body by way of the delicate membranes surrounding the eyes, the respiratory tract, the digestive tract, the skin, and the genitourinary system.	5
114.	Most disease germs cannot live without warmth, moisture, food and darkness.	5
115.	Resistance to some communicable diseases depends upon the presence in the body of antibodies which may be manufactured by the body, or brought to the body from some other person or from an animal in which they have been produced artificially.	5
116.	Sleep is necessary for the human body to recover from the effects of nerve and muscle fatigue.	5
117.	Chronic or continued fatigue may be associated with infection and disease, improper hygiene, overwork, mental and emotional upsets, or undernutrition.	5
118.	Exercise aids circulation, increases breathing rate, increases the rate of oxidation, stimulates secretion of perspiration, improves muscle tone, aids digestion and elimination, improves heat regulation, and is conducive to good mental health.	5
119.	In man the prolonged period of parental care makes family life desirable.	5
120.	The functions of the sex glands, or gonads, are to produce germ cells and manufacture hormones.	5
121.	At puberty the reproductive organs mature and begin function resulting in many physical, mental, and emotional changes which extend over several years for both boys and girls.	5
122.	Periodically, under the influence of certain hormones, an additional supply of blood is sent to the inner lining of the uterus; if fertilization has not occurred, the excess blood is discharged from the uterine blood vessels in the menstrual process.	5
123.	The characteristics of the child depend upon the determiners, or genes, in the egg and sperm cells.	5
124.	The mother's health has an important influence upon the offspring.	5
125.	The first and most important purpose of sex is the biological continuance of the race.	5
126.	Venereal infections arise almost entirely from promiscuous or casual sexual relationships.	5
127.	The combination of physical, mental, and emotional characteristics in one person is always different from the combination in another person; thus, each individual has his own particular health needs.	5
128.	Inflammation and irritation of the gums may be caused by malocclusion, faulty dental work, the accumulation of tartar around the	5 5

Rank	Major fundamental concepts	Modal value
	neck of a tooth, lack of vitamin C in the diet, careless use of dental floss or toothbrush, and infectious diseases such as pyorrhea and Vincents' Angina.	
129.	All human beings originate as a single fertilized egg produced by the union of two sex cells.	5
130.	Heredity establishes the framework and maximum development of the individual; and environment, acting on the material supplied by heredity, determines how far development shall go.	5
131.	Each individual possesses physical, mental, and emotional characteristics which determine his personality; these characteristics may be inherited or acquired through education and experience.	5
132.	Individuals do not inherit disease but may inherit cell weaknesses, or tendencies, which make them susceptible to certain diseases.	5
133.	Life expectancy depends on age, race, sex, occupation, climatic conditions, and heredity.	5
134.	Different degrees of mental ability as well as some forms of feeblemindedness are inherited.	5
135.	Methods of preventing infection include those carried out by public health officials and private physicians, and those carried out by people for themselves.	5
136.	Preventable diseases are those diseases from which people can be protected by immunization, sanitary or aseptic conditions, proper food selection, chemical products, serums, organic extracts, drugs, or surgery.	5
137.	The antigen-antibody reaction is the basis of all vaccine treatment.	5
138.	The body's first line of defense against disease is the army of white blood cells, or leucocytes, which attack any bacteria or foreign particles in the blood.	5
139.	Modern hospitals afford the instruments and laboratory equipment necessary for making accurate diagnosis, the devices for medical and surgical treatment proved to be useful and safe, and staffs of physicians and surgeons who are skilled in their chosen specialties.	5
140.	Symptoms besides pain which require a physician's attention are abnormal temperature; skin rashes; rapid loss of weight; blood in the sputum, urine, or stools; marked increase or decrease in urination; unusual discharges from any part of the body; the failure of a sore to heal; or a lump or growth in body tissues.	5
141.	Every individual regardless of age, should have periodic health examinations.	5
142.	One of the most important factors in the successful treatment of disease is early recognition.	5
143.	Defects that cannot be corrected may be compensated for in planning one's way of living and one's vocation.	5
144.	The chief dangers against which the family food supply must be guarded are the adulteration of foods with harmful substances, poisonous sprays on fruits and vegetables, and disease parasites, bacteria, and the products of bacterial growth.	5
145.	By pasteurizing milk all disease bacteria are destroyed and only a fraction of other harmless bacteria present remains alive.	5
146.	The two main purposes of first aid are: (1) to have sufficient knowledge to determine the extent and seriousness of an injury or sudden illness, and (2) to give proper first-aid care after the needs are determined.	5
147.	It is essential that the first-aider know what not to do as well as what to do in case of accident or injury.	5

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148.	Shock is a condition in which the body processes are retarded or depressed and is brought on by injuries, poisoning, severe bleeding, burns, suffocation, and strong emotions.	5
149.	Organs are composed of tissues and they are adapted to special functions of life.	4
150.	Cells that are specialized in performing one certain function for the body combine to form tissues; there are as many kinds of tissues as there are cells.	4
151.	One cell may exist alone and do everything for itself in maintaining life.	4
152.	Muscles are arranged in pairs so that one opposes action of another.	4
153.	All muscle cells, which make up the muscles, are capable of contracting.	4
154.	Good muscle tone is essential for good posture and for physical fitness.	4
155.	A muscle works, or contracts, by becoming shorter and thicker so that its two ends are brought closer together.	4
156.	The rate of growth and the composition of bones change throughout life.	4
157.	Bones are held together at the joints by bands of tough, inelastic connective tissue called ligaments.	4
158.	The red corpuscles and leucocytes of the blood are formed in the marrow of the large bones.	4
159.	The rate of the heartbeat is regulated by the autonomic nervous system, and therefore is affected by the emotions.	4
160.	Blood pressure depends upon the force of the heart and the size and position of the vessels and the stage of the pulse cycle.	4
161.	The liver and spleen both aid in changing worn-out red blood cells into substances that can be used again in the body.	4
162.	Lymph nodes assist in protecting the body through their action on bacteria and through the building of white blood cells.	4
163.	Blood clots normally on the surface of the body and within the body, except within the circulatory system.	4
164.	The lymph which bathes the cells is produced by the filtering of some of the blood plasma through the capillary walls.	4
165.	The general condition of the arteries is a major factor in the aging process.	4
166.	Hardening of the arteries is a result of the loss of elasticity of the fibers in the arterial walls, thus curtailing the blood supply to various parts of the body.	4
167.	Hemophilia is an hereditary condition in which the blood fails to clot when the skin or mucous membrane is broken.	4
168.	Chemical digestion is brought about by enzymes, manufactured and secreted by glands at various points along the digestive tract, which cause food substances to undergo chemical changes without combining chemically with the food or undergoing any changes themselves.	4
169.	The extent of digestion and absorption in the small intestine is determined to some extent by the length of the intestine and the amount of time that food remains in it.	4
170.	Alcohol and certain poisons are absorbed directly into the blood stream from the stomach.	4
171.	The individual's energy requirements vary with age, sex, body weight, and the amount and kind of work done.	4
172.	Body weight is closely related to inheritance, age, height, and sex.	4

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173.	Human and animal excreta are dangerous because they may contain the parasites or micro-organisms which cause intestinal diseases.	4
174.	The colon retains food wastes until most of the water is absorbed from them and they are ready to be eliminated from the body in comparatively solid form.	4
175.	The blood carries the secretions from the endocrine, or ductless, glands to cells, tissues, and organs in all parts of the body.	4
176.	The process of breathing includes inspiration, or breathing in, and expiration, or breathing out; these functions follow one another in regular, or rhythmic, succession.	4
177.	Both in inspiration and in expiration, the lungs are passive, with the diaphragm and the chest doing most of the work.	4
178.	The rate and depth of breathing are regulated automatically by a control center in the brain which is extraordinarily sensitive to variations in the carbon dioxide content of the blood.	4
179.	Normal tonsil and adenoid tissue functions in screening out bacteria and destroying them.	4
180.	Color, texture, and quality of the skin is a good indication of general physical condition.	4
181.	The senses function in helping the body to carry on a variety of activities.	4
182.	Ultraviolet rays, acting on any part of skin, affect the whole body.	4
183.	The large number of sweat glands in the skin and the network of capillaries help keep body temperature normal.	4
184.	As perspiration evaporates from the skin, it cools the surface of the body; thus the greater the evaporation, the greater is the cooling effect.	4
185.	The maintenance of a fairly even body temperature is necessary to health.	4
186.	Heat is constantly produced in all the cells of the body by the oxidation of food.	4
187.	The eyes can be used continuously, during normal waking hours, without becoming fatigued if they are used under proper conditions.	4
188.	Errors of refraction arise from a variety of conditions, but usually because the eyeball is too short or too long from front to back, or because the crystalline lens loses its elasticity.	4
189.	Besides defects in the structure of the eye which cause errors of refraction, the eyes are subject to disorders of an infectious nature.	4
190.	Deafness rarely begins suddenly in adult years but usually arises in childhood and becomes progressively worse if neglected.	4
191.	The primary unit of structure of both the central nervous system and the autonomic nervous system is the neuron which functions as a carrier of impulses from one part of the body to another.	4
192.	The autonomic nervous system and the endocrine system together regulate the internal functions of the body without conscious direction on the part of the individual.	4
193.	The nervous system is influenced by the same factors that affect the health status of other parts of the body.	4
194.	The autonomic system controls and regulates automatically certain digestive, circulatory, and other vital processes.	4
195.	The cerebrospinal system, consisting of the brain and spinal chord, controls all voluntary functions and helps regulate certain involuntary functions.	4
196.	Each nerve in the body has a definite location and a specific purpose or function.	4

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197.	The nervous system is particularly sensitive to narcotics, anesthetics, and stimulants.	4
198.	Reflex action, the simplest function of the nervous system, involves response, by muscular contraction or glandular secretion, to the stimulus of a sense organ.	4
199.	Alcohol has a depressant effect on the nervous system which in turn affects all the functions of mind and body.	4
200.	Insects may spread disease by transporting harmful organisms which they transfer directly or indirectly to man.	4
201.	Certain pathogens have poisons, or toxine, already formed within themselves when they arrive in the body and are ready to do harm at once; other pathogens produce toxins while nourishing themselves in or on the body.	4
202.	Diseases can be spread by direct or indirect contact.	4
203.	A disease is communicable as long as the germs are present in the discharges of the body, in open sores that harbor them, or in the scales of infected skin.	4
204.	The period intervening between the time when the disease germs enter the body and the time when the patient begins to feel ill is called the "period of incubation."	4
205.	During sleep, pulse rate and blood pressure decreases, breathing is slowed, and the glands of the body diminish their functions.	4
206.	The chief value of exercise is to increase the ability of the body to do physical work, to improve endurance and resistance to fatigue, and to produce grace and perfection of movement.	4
207.	The egg cell is not only fertilized within the body of the mother, but the resulting embryo grows to considerable size before it emerges to an outside environment.	4
208.	The menopause, or time at which the woman's capacity for bearing children comes to an end, usually occurs after the fortieth year of life.	4
209.	In men there is no well-defined time of cessation in reproductive capacity, but a definite decrease in sexual activity usually begins before the age of sixty years and is sometimes accompanied by disturbance of emotional balance.	4
210.	During pregnancy the fertilized egg grows into a new being capable of independent existence; for approximately nine months the mother contains and nourishes the new life within her own body.	4
211.	The height of an individual is largely determined by heredity and environment.	4
212.	Inherited characteristics depend upon the genes which were present in the fertilized cell from which the body developed.	4
213.	The transmission of human qualities occurs according to Mendel's law which states that opposing characteristics in the male and female parents do not blend but remain distinct in the germ cells of the offspring, recombining in future generations according to the law of probability and chance.	4
214.	Against the invasion of pathogenic or disease-producing microorganisms, the body has both specific and nonspecific lines of defense.	4
215.	Vaccines cause the blood and other tissues to develop antibodies for fighting active organisms of disease but do not cause the disease because of their lifeless or weakened condition.	4
216.	Nonspecific immunity, or body resistance to many different diseases, is affected by fatigue, chilling of the body, unhygienic living con-	4

Rank	Major fundamental concepts	Modal value
	ditions, inadequate diet, lack of vitamins, and by the occurrence of some other infection.	
217.	Acquired immunity comes from having the disease or through the use of vaccines, toxoids, and serums; this type of immunity is effective against a single disease.	4
218.	The need of protecting others from infection is an important consideration in the nursing of someone ill with a communicable disease.	4
219.	A growing number of diseases and infections are curable by a chemical product, a serum, or an organic extract; with other diseases drugs may be of great value, although they do not cure; in still others, radiation or surgery may save life or prolong it.	4
220.	Voluntary health agencies carry on research, educate the public, and in some instances, give actual assistance to the sick, the poor, the homeless, and the aged.	4
221.	Food allergy, resulting from an individual's sensitivity to a chemical substance in the food, may produce a skin rash, asthma, headache, or digestive upset.	4
222.	Bones are composed partly of living cells supplied with blood vessels and nerves and partly of large amounts of hard non-living materials that make up the bone proper.	3
223.	Continuous interference with the blood supply to any part of the body causes cells in that area to degenerate.	3
224.	Heart disease may be either valvular or degenerative.	3
225.	Functional heart disease occurs when the heart, for some reason, fails to perform properly, although there is no organic defect.	3
226.	Coronary thrombosis is caused by a chronically diseased condition of one or more of the coronary arteries.	3
227.	There are individual differences in the storage of food in the body in the form of fat.	3
228.	The storage and utilization of sugar is controlled by a substance called insulin, which is produced in the pancreas and secreted directly into the blood stream.	3
229.	Undigested parts of the food remain in the intestines to be eliminated from the body.	3
230.	The body burns its stored fuel when more energy is needed than is supplied by the immediate food intake.	3
231.	The measure of the energy supplied by any given amount of food is a unit of heat called a calorie.	3
232.	Minerals in the diet provide substances for regulation of action of the cells in carrying on body processes.	3
233.	Metabolism includes the sum total of activity which takes place in the cells of the body.	3
234.	Basal metabolism involves only those chemical processes which are carried on when the body is at a complete rest.	3
235.	The body eliminates undigested food and cell waste products by the process of defecation.	3
236.	The use of cosmetics is primarily to improve the appearance of the skin.	3
237.	Receptors in muscles, tendons, joints, and the skin are stimulated by motion and changes of position.	3
238.	When the temperature of the medium surrounding the skin is considerably higher or lower than that of the skin, heat loss is greatly retarded or speeded up.	3
239.	Binocular vision comes about through coordinated movements of the	3

Rank	Major fundamental concepts	Modal value
	eyeballs in their orbits and the interpretation by the brain of the two pictures appearing on the retinas.	
240.	Some types of blindness are hereditary, but in most cases blindness is acquired and usually as a result of an infection or accidents.	3
241.	Nervous disorders may be either structural or functional.	3
242.	Drugs are usually not specific cures for disease, but they are of value because they control undesirable reactions, support some body function, or lessen pain.	3
243.	Infection results when germs get into the body and grow.	3
244.	Fatigue may be either physical or mental.	3
245.	The body readily recovers from ordinary, normal fatigue.	3
246.	Because their bodies are growing and their metabolic rate is greater, young people need more exercise than adults.	3
247.	Healthy gums are dependent upon proper oral hygiene and diet.	3
248.	The exchange of nutrients and waste products is carried out between the plasma and the cells by the process of diffusion.	3
249.	The alkaline-acid balance of the blood and lymph is just on the alkaline side of neutrality and is so regulated that about the same degree of alkalinity is constantly maintained.	3
250.	Sounds are made by the vibration of the two vocal chords when exhaled air passes over them.	2
251.	Sebum, which is the secretion of the sebaceous glands, serves as a natural oil for the skin and hair.	2

Free Health Literature—How Effective Is It?[1]

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THE FREE pamphlet is a tool widely used by health educators to extend their influence as far into the community as possible. What happens to this literature once it has been distributed? Is it read? If it is, does it increase health knowledge? These are questions which have long challenged us since it has been our practice to send "popular" health pamphlets to the parents of our students in an attempt to reach beyond the confines of our metropolitan classroom. The present study was undertaken to determine whether, when they are willing to cooperate in a research study, the level of health knowledge of parents of students in a prescribed hygiene course can be raised if they receive pamphlets whose contents are related to the subjectmatter of the course.

The method used was to test parent-subjects before and after a three-and-a-half month period during which health literature was distributed to an experimental but not to a control group. The assumption was made that changes in the level of knowledge could be assessed by a comparison of pre- and post-test scores on an objective-type questionnaire. The subjects were not informed at the time of the first test of its purposes nor that anything further would be required of them. Since the measurement of factual knowledge may not be a true index of understanding, it was hoped that any factual gain observed would represent the minimum gain and that attitudes and practices would also be improved.

Methods

It was decided to work with certain health topics (see below) which were important in this community. Samples of literature on these topics, which were available for free distribution, were obtained from voluntary, commercial, and public agencies. On each topic, we selected that pamphlet whose contents would best serve as a basis for objective questions. The pamphlets finally chosen were, in order of issuance:

[1] This study was made possible by grants from the Nora and Abbie (Nooney) Scholarship Fund of Hunter College. We are also indebted to the Bureau of Social Research, Columbia University, the Health Council of Greater New York and Professor James R. Meehan of Hunter College for their assistance. It was prepared in cooperation with the Bureau of Public Health Education and the Bureau of Records and Statistics of the New York City Department of Health.

Title of pamphlet	*Source*[2]
Diabetes (incidence, diagnosis, treatment)[3]	The Metropolitan Life Insurance Company
The Family Food Supply (nutritional requirements, economic considerations)	The Metropolitan Life Insurance Company
Rheumatic Fever (signs and symptoms, care)	The Metropolitan Life Insurance Company
Questions and Answers about Syphilis and Gonorrhea (signs, precautions, treatment)	The American Social Hygiene Association
What You Can Do—About Tuberculosis (individual and community aspects of reducing incidence and mortality)	The John Hancock Mutual Life Insurance Company
There Is Something YOU Can Do About Cancer (detection, prevention, therapy)	The Metropolitan Life Insurance Company
What About Your Heart? (symptoms and prevalence of different types of cardiovascular disease)	The American Heart Association
What About Mental Illness? (classification, causes, treatment, prevention)	The Division of Mental Hygiene of the Ohio Department of Public Welfare

A previously tested questionnaire consisting of 50 multiple-choice questions (including "don't know") was framed from facts specifically stated in the chosen pamphlets. The questionnaire was administered under controlled conditions to parents of students in prescribed hygiene and history classes which were chosen at random. Of the total number of families whose cooperation was solicited, about 90% of those of hygiene students and approximately 60% of those of history students participated.

Table 1 indicates some characteristics of the population who completed the study.

This population was divided into an experimental group, AB, (final total, 165), whose daughters were in hygiene classes, and a control group, C (final total, 77), whose daughters were in history classes. During the three-and-a-half months following the administration of the first questionnaire, eight pieces of literature were distributed to each member of the AB group at intervals of about 10 days. In order to insure receipt of the literature by a sizable number of subjects and also to test a method of distribution which might be used outside of a college campus, the AB group was subdivided as follows:

A. Parents of students in four of the hygiene sections, chosen at random. Pamphlets were distributed to all students with instructions to deliver one to each parent.

B. Parents of students in the remaining six hygiene sections. Pamphlets were mailed to each subject in envelopes of the New York City Department of Health.

At the end of the period of literature distribution, the parents of all three groups—A, B, and C—were retested on the questionnaire which had been previously administered.

The A, B and C groups were compared for distribution of sex, education,

[2] We are appreciative of the assistance of these organizations in making available a sufficient number of pamphlets.

[3] Topics in parentheses indicate points of major emphasis in the pamphlets.

and rating on the first questionnaire. There were no statistically significant differences between the groups in these respects. There was a strong tendency for the more highly educated subjects to have higher initial scores (above mean). It is also of interest to note that whereas the average levels of initial information of the men and women were not far apart, the men as a group appeared to know more about venereal disease whereas the women were evidently superior in their knowledge of diabetes, rheumatic fever, and nutrition.

Of the 270 original participants, 28 did not take the second questionnaire. Of these, all but six[4] dropped out for such reasons as death, prolonged illness, absence from the city during the second test period. There was no statisti-

TABLE 1

Characteristics of the total population

CHARACTERISTIC	NUMBER	PERCENTAGE OF TOTAL*
Sex		
Male	103	42.5
Female	139	57.5
Primary education in English-speaking country	171	75.0
Educational status		
High (at least some college)	77	32.2
Intermediate (at least some high school)	106	44.4
Low (no high school)	56	23.4
Present occupation		
Housewife	103	43.2
Managerial, professional, upper white-collar	47	19.7
Lower white-collar, skilled, semi-skilled, unskilled	88	37.0
Initial score of 25 or more (total number of questions 50)	143	59.1

* Since a few people failed to answer every question, the totals upon which the percentage figures are based varied from 228 to 242.

cally significant difference between the original population and the drops when they were compared for sex and education.

Results

Whenever literature is not distributed by person to person contact, the question arises as to how much reaches the subject and how much of that which does reach him is actually read. This study did not thoroughly investigate the problem of distribution, but it was found that of the group receiving literature by mail, an average of 64% remembered seeing the pamphlets, whereas, of those who might have received them from their daughters, an average of only 46% remembered seeing the pamphlets. An

[4] Of these six, four dropped from the experimental group (AB) and two from the control (C).

average of 66% of those members of each experimental group who reported seeing the pamphlets actually read them. Table 2 incorporates the responses of these subjects to questions on exposure to each of the pamphlets sent them.

Table 3 presents data regarding initial and terminal scores and mean change in score.

TABLE 2

Percentage of experimental subjects who saw and read pamphlets

PAMPHLET ON	I PERCENTAGE OF GROUP WHO INDICATED SEEING EACH PAMPHLET		II PERCENTAGE OF PEOPLE WHO SAW PAMPHLET (FROM COLUMN I) WHO *read* IT	
	A (received via daughter)	B (received via mail)	A	B
Diabetes	64.7	74.5	65.2	74.2
Nutrition	49.2	73.5	60.0	53.4
Rheumatic fever	43.6	69.0	61.4	66.0
Venereal disease	36.6	46.8	69.2	63.5
Tuberculosis	39.4	52.0	64.3	61.2
Cancer	58.0	66.0	69.0	74.0
Heart disease	35.2	54.2	68.0	70.5
Mental health	38.0	73.4	74.0	63.6
Average	45.6	63.7	66.4	65.8

TABLE 3

Results on first and second test

SCORE	NUMBER OF QUESTIONS ANSWERED CORRECTLY	
	AB (experimental)	C (control)
Mean initial score	25.96	25.62
Mean terminal score	27.89	25.46
Mean change in score	1.93	−0.16

Comparison of initial and terminal scores:
AB, $t = 3.19$, $p^* = <1\%$; C, $t = 0.19$, $p = >5\%$
Comparison of score changes of AB and C: $t = 3.32$, $p = <1\%$
* p indicates the probability that the observed change is due to chance.

From the data of Table 3 it will be noted that the experimental group made a statistically significant gain in score whereas the control group remained about the same.

When the changes in score were analyzed on the basis of educational level, it was found that there was no statistically significant[5] difference between score changes of the more and of the less educated subjects, among either the experimentals or controls.

[5] The level of significance used throughout this paper is p = 1% unless otherwise stated.

It is of interest that in the experimental group the average score change of the women was statistically significant, while that of the men was not; in the control group, neither sex achieved a statistically significant change in score (Table 4).

In connection with the data of Table 4, we might point out that the women appeared to have seen more of the literature than the men. Of the group to whom the pamphlets were delivered by mail, 78% of the women but only 46% of the men recorded having seen five or more of the eight

TABLE 4

Score changes of men and women

SCORE	NUMBER OF QUESTIONS ANSWERED CORRECTLY			
	AB		C	
	Men	Women	Men	Women
Mean initial score	23.78	27.48	24.46	26.60
Mean terminal score	25.25	29.76	23.57	27.05
Mean change in score	1.40	2.28	−0.89	0.45

Comparison of initial and terminal scores:
AB: men, $t = 1.40$, $p = >5\%$; women, $t = 3.42$, $p = <1\%$
C: men, $t = 0.59$, $p = >5\%$; women, $t = 0.52$, $p = >5\%$

TABLE 5

Changes in score on individual topics

TOPIC	PERCENTAGE OF INCREASE IN RIGHT ANSWERS		MEAN SCORE CHANGE (fraction of questions)		p*	
	AB	C	AB	C	AB	C
Venereal disease	8.7	0.8	0.61	0.06	<1	>5
Heart disease	6.7	2.0	0.20	0.06	<1	>5
Diabetes	8.0	2.6	0.24	0.08	<1	>5
Mental health	3.5	0.6	0.28	0.05	>5	>5
Rheumatic fever	3.4	−3.0	0.20	−0.21	>5	>5
Cancer	1.5	1.0	0.06	0.04	>5	>5
Tuberculosis	1.3	−0.7	0.08	−0.04	>5	>5
Nutrition	1.8	−0.5	0.20	−0.06	>5	>5

* p is calculated for mean change in score.

pamphlets. In examining the responses of the entire experimental group, it was found that of the total number of subjects who recorded having seen each pamphlet, an average of 71% of the women but only 56% of the men actually read them.

Table 5 presents the percentage of increase in right answers and the mean changes in score achieved by experimental and control subjects in each topic.

As may be observed from Table 5, the experimental subjects showed a statistically significant increase in score in certain topics. In no topic did the controls manifest a significant gain. In order to evaluate possible factors which might have been operative in producing the different score changes

noted in the separate topics, relevant information is presented in Table 6 along with the t values of these changes.

Even though there was no apparent gain in knowledge in certain topics as a whole, there were questions on each topic in which a gain was achieved by the experimental group. A comparison of initial and terminal scores on single questions on each topic yielded the following p values: p = <1% for at least one question on each topic (actually there were many more) except tuberculosis, where the most significant change in a question gave the result, p = >1% but <5%. On the other hand, there was but a single question of the total number of 50 in which the answers of the C group showed a statistically significant increase in score; this was a question on mental health in which p = <1%.

TABLE 6

Score changes on topics, in relation to pamphlet

TOPIC	RATING OF PAMPHLET*	AVERAGE PERCENT OF RIGHT ANSWERS ON INITIAL TEST (groups A, B, C)	PERCENT OF GROUP AB WHO READ EACH PAMPHLET	STATISTICAL SIGNIFICANCE OF SCORE CHANGE ††	
				AB	C
Venereal disease	4	36.2	28.0	4.67	0.34
Heart disease	2	44.7	33.3	3.10	0.53
Diabetes	1	50.3	49.6	2.92	0.61
Mental health	8	34.9	38.8	1.85	0.27
Rheumatic fever	4	64.4	37.5	1.60	1.20‡
Cancer	4	51.4	45.5	0.86	0.35
Tuberculosis	6	56.8	29.0	0.81	0.28‡
Nutrition	7	59.0	35.0	0.28	0.23‡

* Judgment of the effectiveness of the pamphlets was based on appearance, prominence of answers, clarity. The pamphlet which we considered best was rated number 1.

† For p = 1%, t = 2.601.

‡ Negative score change.

Of the total number of subjects in the experimental group, only a certain proportion read each pamphlet. In order to evaluate the effect that the literature may have had in adding to factual information, the improvement made in each topic by those members of the AB group who stated that they had read the relevant pamphlet was studied. A statistical analysis is not possible because the group of subjects who read any particular pamphlet forms a self-selected segment of AB, unmatched either with any similar segment of AB or with C. However it is of interest to note the percentage improvement on each topic made by those who read the pamphlets as compared with the controls (Table 7).

It would appear from the data in Table 7 that the people who read the pamphlets increased their knowledge whereas the controls did not. The range of improvement, from 14% in the case of diabetes to 2 % in cancer, may be an indication of the effectiveness of these pamphlets in presenting the information required by the questionnaire.

Health information acquired through sources other than the pamphlets must be considered as a factor in increasing the knowledge of all the subjects. In the control group, the median number of outside contacts (radio, press, magazines; conversations with physician or with daughter studying hygiene) on the topics covered by the experiment was seven. It was found that a far larger percentage (78%) of the experimental than of the control (56%) group remembered having had seven or more such outside educational contacts. Since these two groups were of similar composition, it would seem as though the receipt of the pamphlets had influenced the experimental subjects so that they were more aware of other sources of health information.

TABLE 7

Comparison of increase in topic scores of those experimental subjects who read each pamphlet, and of controls

TOPIC	PERCENTAGE INCREASE IN RIGHT ANSWERS	
	AB subjects who read pamphlet	C
Diabetes	14.0	1.4
Venereal disease	10.6	1.3
Rheumatic fever	8.5	−3.8
Mental health	7.7	1.1
Heart disease	4.3	−0.9
Tuberculosis	3.7	−0.7
Nutrition	2.4	0.1
Cancer	2.0	1.1

Discussion

The results indicate that the level of knowledge of these parents of college hygiene students who received free health pamphlets has been raised. A comparison of the mean score changes of the experimental and control subjects shows a statistically significant difference between the increase noted in the experimental group and the negligible change in the control group. This difference is even more meaningful in view of the fact that the control group, representing a smaller proportion of the entire pool of potential subjects than the experimental, was more highly self-selected and therefore may have represented a more interested group, more alert to health information. The fact that the controls did not change their scores appreciably leads us to believe that whatever alerting effect the initial questionnaire may have had was not apparent after three-and-a-half months. This lack of gain further indicates that the sources of information available in the environment during this period did not operate to raise their level of information measurably.

The improvement of the experimental subjects may have been due to several factors: (a) the actual information contained in the pamphlets, interest in which may have been stimulated in part by the questionnaire itself; (b) everyday incidental learning; (c) the effect of the literature in

alerting the subjects to other educational influences; and (d) the direct transmission of information from the classroom by the subjects' daughter. In view of the fact that no appreciable change in the level of knowledge of the controls was observed, it does not seem likely that environmental influences alone would have increased the information level of the experimentals. Since the areas of greatest improvement on the test did not coincide with the degree of classroom emphasis, it does not appear that direct transmission by the daughters could have been an important factor in improving the score. Although this study did not enable us to investigate all the factors which operated to raise the level of information, we believe that the pamphlets played an important part, both because of the information they contained and because of their apparent production of a heightened awareness to educational factors in the environment. This impression is reinforced by the apparently close correlation between improvement in particular questions with the degree of clarity and prominence of their answers in the pamphlets. Also by the fact that the men, who read considerably less of the literature than the women, did not as a group achieve a significant gain.

It should be mentioned that the scores of some subjects of both groups actually fell, even though the mean score change of the experimental group was a statistically significant one. This is not an unusual finding in studies of this kind.[6] Likewise it should be noted that the net score change in some instances represented multiple shifts in first and second answers, from right to wrong as well as wrong to right. Unfortunately we were unable to study this aspect of the problem.

In analyzing the gains in different topics, we found that in some instances, for example cancer, a small gain on the entire topic obscured the large increment in right answers to one question of the series. We believe that if even one fact that may possibly lead to action can be learned by an appreciable number of people, there is some value in distributing literature in this way. The influences which promoted an increase in score in one field rather than another could not be fully evaluated; recency of reception of a pamphlet was not a factor. It would appear that the degree of score change in any one field was correlated with a low initial level of knowledge and with brevity and clarity of the pamphlet, particularly if there were strong external catalyzing influences, such as the venereal disease campaign which took place during the experimental period.

Conclusions

1. The sending of health literature to 165 parents of college hygiene students raised their average level of information appreciably. This conclusion is supported by comparison of the scores obtained on a series of 50

[6] Garrett, Henry E. *Statistics in Psychology and Education*, New York: Longmans, Green and Company, 1947.

multiple-choice questions on which the experimental subjects were tested before and after a three-and-a-half month period during which literature was distributed. No comparable change in score was shown by 77 control subjects.

2. An average of 46% of the experimental group who were to have received the literature at intervals from their daughters and an average of 64% of the group who received it by mail remembered having seen it. An average of 66% of the segment of each group who recorded having seen the pamphlets actually read them.

Endurance Tests for 4-H Club Members

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HEALTH is considered to consist of four parts, namely, *body growth, organic soundness, motor fitness, and body protection.* In general the 4-H Club program has placed most emphasis on growth and protection—protection meaning knowledge of sanitation, disease prevention, safety, and first aid, as well as skill in swimming. In Illinois, however, the health program (7–9) has been expanded to include the areas of organic and motor fitness (10, 11).

The foundations of health are laid during childhood. They consist largely of adequate food and sleep, vigorous exercise, fresh air and sunshine, and freedom from disease and defects. Although a comprehensive health program includes all of these things, only one aspect—endurance—is being reported here.

This report describes the procedures used in developing and standardizing certain endurance tests. The tests are group tests which were administered at county field days in Illinois. Testing has been emphasized as a means toward achieving motor fitness, because boys and girls will generally become interested in an activity when they have some way to measure the progress they are making.

The benefits of exercise have been well-argued by Dawson, McCurdy and Larson, Schneider, and Wiggers, but in spite of their arguments many fitness programs have been mainly talk. Parents and teachers seem willing to make lectures on fitness compulsory for children—but not the practice. Yet, the only way one can reap the benefits of exercise is to exercise. The human body is adapted to activity. All of its parts maintain their efficiency through use, and they lose their efficiency through disuse. Many of the body systems are interrelated, and weakness in one part may disturb or destroy the functioning of the other parts.

Kepler (13) reports that between 5 and 10% of the patients coming to the Mayo Clinic are classed as chronically tired. But although they are tired, what they need is more—not less—exercise. They merely lack condition and endurance. About 68% of those examined at Peckham (14) were neither sick nor healthy—just devitalized. They were compensating for their disorders by refusing to take part in any activity. "Compensation," said Dr. Pearse, "masks the disorder and deceives the individual into a false sense of well-being."

Of the motor fitness factors identified as agility, balance, endurance, flexibility, and strength, endurance seems to be by far the most important

to life-long general fitness. Although endurance has psychological elements, only its physical manifestations were considered in devising the tests described below which were used in the Illinois 4-H Club program.

600-yard run

During the first two years (1943–44) in which the tests were given, the 1000-yard run was used as an endurance test; but because only half of the 800 boys and one-tenth of 500 girls were willing to undertake and finish it, it was discarded in favor of the 600-yard run. During the next four years (1945–48), 3965 boys and 3631 girls, or 95.2% of those taking part in the field days, ran the 600 yards. Because of bad weather and the polio epi-

TABLE 1

600-Yard run: average scores in minutes for boys by age groups

AGE (MO.) DIVIDED BY 10	AVERAGE SCORES FOR ALL RUNNERS, 1945–48	AVERAGE SCORES WHEN SLOW RUNNERS WERE REJECTED	POINT ABOVE WHICH SLOW RUNNERS WERE REJECTED	AVERAGE SCORES FOR THOSE REPORTED TO HAVE RUN ALL THE WAY 1947–49	PREDICTED SCORES FOR DISTRIBUTION SHOWN IN COL. 2	PREDICTED SCORES FOR DISTRIBUTION SHOWN IN COL. 4
	1	2	3	4	5	6
12	2.585	2.541	3.50	2.542	2.541	2.542
13	2.533	2.494	3.40	2.471	2.494	2.462
14	2.425	2.393	3.30	2.389	2.398	2.389
15	2.341	2.311	3.20	2.315	2.306	2.315
16	2.235	2.209	3.10	2.234	2.205	2.225
17	2.146	2.123	3.00	2.134	2.108	2.122
18	2.039	2.026	2.90	2.011	2.026	2.032
19	1.939	1.926	2.80	1.907	1.961	1.964
20	1.931	1.926	2.70	1.918	1.912	1.918
21	1.902	1.902	2.60	1.874*	1.877	1.890*
22	1.850	1.850	2.50	1.821*	1.853	1.873*
23	1.894	1.875	2.40	1.919*	1.836	1.864*

* Less than 50 cases.

demic in 1949, this feature was not included in several counties. However, during the five years 1945–49, 90.2% of 10,282 boys and girls have run the 600 yards without apparent difficulty.

Those in charge of the project set out to devise a standard score table to be used as the basis for measuring the progress of individuals and county groups from year to year and for comparing programs in different counties.

The average scores on this test showed increases with age which resembled growth curves. But the distribution of scores within an age group formed a positively skewed curve which proved to be a poor fit to the normal distribution according to the chi-square test. Two problems—one the skewed distributions and the other the growth increases—therefore had to be solved.

Many distributions of physical test data resemble the logarithmic normal curve, but in this case it appeared that the skew was increased because there were two overlapping distributions—one a "run" and the other a "run and walk" distribution—which should be separated. Thereafter the

scorekeepers were asked to indicate whether their buddies had run all the way or had walked part of it. The scores for those having run all the way, when plotted by age group on semilogarithmic paper, resembled the normal bell-shaped curve.

In order to utilize as much of the data as possible, it was decided to reject scores above certain limits (see Table 1), presumably those of the walkers, and to compare the resulting distributions with those of the known runners. Figure I shows the comparisons for the 160–170 month age group.

Since the average scores increased with age, smoothed growth curves were calculated by means of Courtis's equations (1, 2) and are shown as the pre-

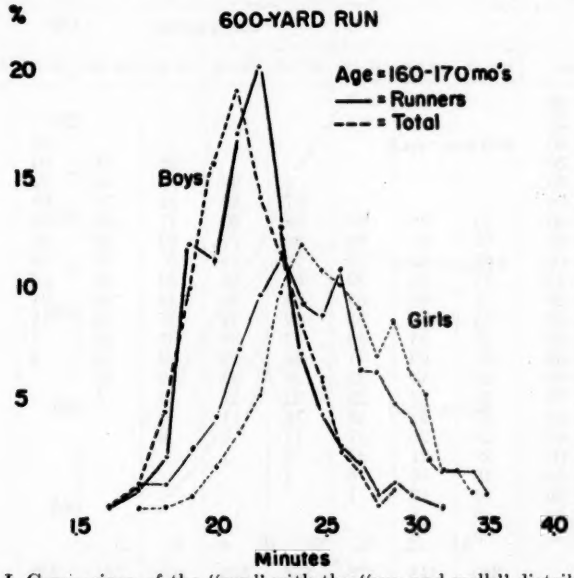

FIGURE I. Comparison of the "run" with the "run and walk" distribution when scores above 3.10 for boys and above 3.50 for girls were rejected. Plotted on semilogarithmic paper.

dicted average in Table 2 and as column 5 in Table 1. Because the predicted scores for the "run" distribution differed so little from the total distribution from which certain scores, presumably those of the walkers, had been rejected, it was decided to use the larger population in calculating the standard scores.

The growth curve for the boys was found to be a compound curve with two maxima. The dotted extensions in Figure II show each cycle completed. Apparently two sets of influences are operating together to give the rapid acceleration between 140 and 170 months of age. Had the data included boys under 120 months of age, the curve would no doubt have shown another lower cycle.

Standard scores are based on normal distributions. In order to use the technic with logarithmic normal distributions, the scores for each age group were plotted on semilogarithmic paper. The mean log and standard deviation log were then calculated according to the equations developed by Davies (3). Then, the standard scores were scaled from the graphs using three standard deviations (S.D.) plus and minus the mean as limits. The standard scores for the boys are shown in Table 2.

TABLE 2

600-Yard run: standard scores for boys by age groups

1945–48*

TIME		AGE IN MONTHS									
Sec. or min.		120–129	130–139	140–149	150–159	160–169	170–179	180–189	190–199	200–209	210–219
72	1.20										
78	1.30										
84	1.40								99	96	96
90	1.50						98	94	90	86	84
96	1.60					98	88	84	79	76	74
102	1.70				97	89	79	75	69	67	64
108	1.80	99	98	95	88	80	71	66	59	58	55
114	1.90	93	90	86	80	72	64	58	49	50	46
120	2.00	85	82	78	72	64	57	50	40	42	38
126	2.10	78	75	70	64	56	50	43	32	34	30
132	2.20	71	68	62	56	49	43	36	24	27	22
138	2.30	64	61	55	49	42	37	29	16	20	15
144	2.40	57	55	48	42	35	31	22	9	14	8
150	2.50	51	49	41	35	29	25	16	2	8	2
156	2.60	45	43	35	28	23	19	10		2	
162	2.70	39	37	29	22	17	14	5			
168	2.80	33	31	23	16	11	9				
174	2.90	28	26	17	11	6	4				
180	3.00	23	21	11	6	1					
186	3.10	18	16	6	1						
192	3.20	14	12	1							
198	3.30	9	8								
204	3.40	5	3								
N =		340	448	476	551	555	460	351	250	163	101
Predicted av.		2.54	2.49	2.39	2.31	2.21	2.11	2.03	1.96	1.91	1.88
Actual av.		2.54	2.49	2.39	2.31	2.21	2.12	2.03	1.93	1.93	1.90
S.D.		1.12	1.12	1.11	1.11	1.11	1.12	1.12	1.10	1.12	1.11

* Calculated from normal logarithmic distributions and predicted average scores for age.

The average scores for girls by age groups do not fit the isochronic growth curve equations. They describe an irregular curve which flattens out much sooner than had been expected. The best scores for girls in each age group were almost equal to the best scores for boys, and in the younger groups the best girls excelled the boys—even boys two years older. These results indicate that girls begin to lose endurance after they have passed 160 months of age. Several explanations can be given for this loss. The most common is found in the social patterns for girls' activities. It seems unfortunate that

girls should approach maturity and its added physical burdens with decreasing endurance.

After re-examination of the data and comparison of American and world endurance records made by men and women, the expected growth curve shown in Figure II was drawn as the best guess at what girls should score.

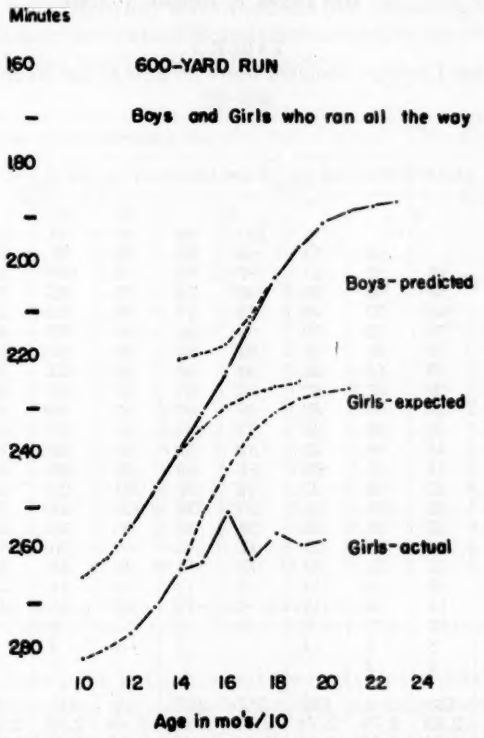

FIGURE II. The isochronic growth curve for boys with each simple cycle extended as dotted lines, and the actual and expected growth curve for girls.

The standard score table for girls shown in Table 3 was then calculated in the same way as that for the boys except that no predicted average scores could be added.

Drop-off index

The drop-off index has been proposed as an endurance index because it shows a person's inability to maintain his short run speed over a longer course. Cureton (4, 5) calculated a difference index: D = (time for longer run) − (ratio of longer distance to shorter distance) × (time for shorter run). Flannagan (6) and Henry and Kleeburger (12) calculated a quotient

index. They defined endurance as the ability to maintain a high level of work without decrement, and they compared measures of work done over long and short intervals, as

$$Q = \frac{1000 \text{ yards} \times \text{weight} \div \text{time}}{100 \text{ yards} \times \text{weight} \div \text{time}}$$

TABLE 3

600-Yard run: standard scores for girls by age groups
1945–48*

TIME		AGE IN MONTHS									
Sec. or min.		120–129	130–139	140–149	150–159	160–169	170–179	180–189	190–199	200–209	210–219
102	1.70						97	99			
108	1.80				100	95	91	93	96	97	
114	1.90		95	98	94	88	85	87	89	90	92
120	2.00	93	89	91	87	82	79	81	83	83	85
126	2.10	87	83	85	81	76	74	75	77	77	78
132	2.20	81	77	79	75	71	69	70	72	71	72
138	2.30	76	72	73	69	66	64	65	66	65	66
144	2.40	70	67	67	63	61	59	60	61	59	60
150	2.50	65	62	62	58	56	55	55	56	54	54
156	2.60	60	57	57	53	51	51	51	52	49	49
162	2.70	55	53	52	48	47	47	47	47	44	44
168	2.80	50	49	47	43	43	43	43	42	39	39
174	2.90	44	45	42	39	38	39	39	38	34	34
180	3.00	41	41	38	34	34	35	35	34	30	29
186	3.10	37	36	33	29	30	31	31	30	26	25
192	3.20	32	32	29	25	26	28	27	26	22	21
198	3.30	27	28	25	21	22	25	23	23	18	17
204	3.40	24	25	21	17	19	22	20	19	14	13
210	3.50	21	21	17	13	16	19	17	16	10	9
216	3.60	18	18	14	9	13	16	14	13	7	5
222	3.70	14	14	11	6	10	10	11	10	4	1
228	3.80	11	11	8	3	7	7	8	7	1	
234	3.90	8	5	4		3	4	4	3		
240	4.00	4	2				1	1			
N =		430	516	536	517	487	326	243	146	96	40
Actual av.		2.83	2.79	2.74	2.67	2.64	2.65	2.65	2.65	2.60	2.62
S.D.		1.14	1.15	1.14	1.14	1.15	1.16	1.16	1.15	1.14	1.13

* Calculated from normal log distribution and actual average scores for age.

Since weight is constant and it seemed desirable to make the values for both drop-off indexes vary in the same direction, the formula was converted to

$$1.00 \div \frac{\text{(speed longer run)}}{\text{speed shorter run}} \text{ or } 1.00 \div \text{distance ratio} \times \frac{\text{time on shorter run}}{\text{time on longer run}}$$

The ratio between the distance for both indexes was 1:10.

At first the 1000–100 yard events were used. Then the 600–60 yard events were substituted.

In order to determine the minimum expected scores when runners were doing their best, American and world championship records were used to

calculate drop-off indexes for all distance ratios. These are shown in Table 4 for all distances up to 1000 meters. Scores when 60 yards (54.8 meters) was used seemed impossible for all distance ratios under 7:1. When 100 yards (91.4 meters) was used, scores were found to be impossible for ratios under 3:1. These facts may be confusing until one realizes that the 200-meter distance is run faster than any other distance (see column 3, Table 4). Drop-off scores for champions when 200 meters was used as the shorter run were more reasonable (see columns 10 to 12, Table 4).

TABLE 4

Drop-off indexes calculated from World's and American Championship Records

DISTANCE METERS	TIME sec.	SPEED M/sec.	RATIO X/54.8	DROP-OFF (54.8)		RATIO X/91.4	DROP-OFF (91.4)		RATIO X/200.	DROP-OFF (200.)	
				D*	Q†		D*	Q†		D*	Q†
54.8	6.0	9.133	1.00	.00	1.00						
60.0	6.6	9.090	1.10	.00	1.00						
91.4	9.4	9.723	1.67	−.62	.94	1.00	.00	1.00			
100.0	10.2	9.804	1.83	−.78	.93	1.09	.08	.99			
200.0	20.3	9.852	3.65	−.16	.93	2.19	.27	.99	1.00	.00	1.00
201.6	20.5	9.834	3.68	−.16	.93	2.21	.45	.99	1.01	.00	1.01
274.3	29.8	9.205	5.01	−.26	.99	3.00	1.59	1.06	1.37	2.00	1.08
300.0	33.2	9.036	5.47	.38	1.01	3.28	2.35	1.08	1.50	2.75	1.09
400.0	46.0	8.696	7.30	2.20	1.05	4.38	4.86	1.12	2.00	5.40	1.14
402.3	46.4	8.670	7.34	2.36	1.05	4.40	5.03	1.12	2.01	5.60	1.14
500.0	63.4	7.886	9.12	8.68	1.16	5.47	11.98	1.23	2.50	12.65	1.25
548.6	69.2	7.928	10.00	9.20	1.15	6.00	12.78	1.23	2.74	13.58	1.25
600.0	78.9	7.605	10.95	13.20	1.20	6.56	17.20	1.28	3.00	18.00	1.30
800.0	108.6	7.366	14.60	21.00	1.24	8.75	26.33	1.32	4.00	27.40	1.33
804.7	109.6	7.342	14.68	21.52	1.24	8.80	26.85	1.32	4.02	27.99	1.35
914.4	129.3	7.072	16.69	29.16	1.29	10.00	35.27	1.38	4.57	36.53	1.39
1000.0	149.6	6.684	18.25	40.10	1.37	10.94	46.76	1.46	5.00	48.10	1.47

* D drop-off = (longer time) − (ratio × shorter time)

† Q drop-off = 100/(distance ratio) (longer distance/time)/(shorter distance/time)

Drop-off indexes for 4-H Club members for both the 1000–100 yard and the 600–60 yard events gave some impossible and many seemingly too low scores.

These facts all made a re-examination of the drop-off index seem important. Logically drop-off scores should decrease as endurance increases, but it is possible for a person to better his score by merely not doing his best on the shorter run. Changes were made in the administration of the 60-yard run to cause each runner to do his best (11).

Because drop-off was designed to be used as an endurance index, it seemed that both events should carry endurance factors. Certainly 60 and 100 yards demand little in endurance. Furthermore, these distances are not run so fast as 200 meters or 220 yards. Runs longer than 600 yards had discouraged high participation by 4-H members. For these reasons, it was decided to try a 600–200 yard combination in 1950.

The distribution of all scores for both D and Q indexes resembles the logarithmic normal curve. The scores for 3865 boys for the 600–60 yards and for 399 boys for the 1000–100 yards are shown in Figure III.

The age distributions likewise were positively skewed but resembled the normal bell-shaped curve when plotted on semilogarithmic paper.

The 600–200 combination is not shown as a graph, but the data are given in Tables 6 and 7 for 548 boys and 632 girls.

The average scores by age groups for the 600–60 combination showed a tendency to decrease for the D index for the boys but not for the girls. No decided trend was shown for either the D or Q index for the 1000–100 or the

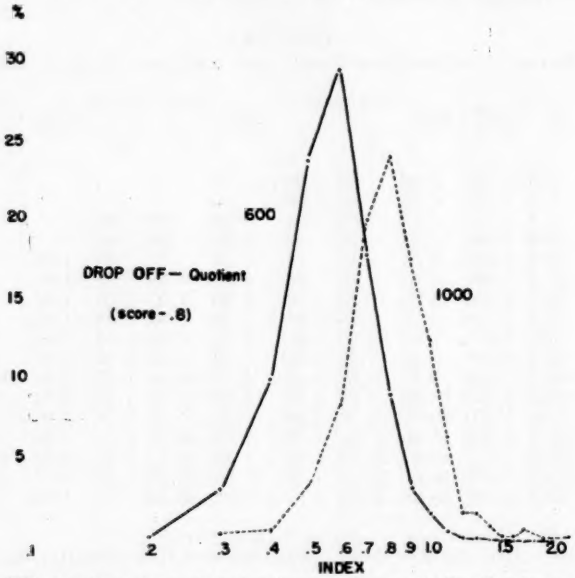

FIGURE III. Quotient drop-off index (score minus 0.8) distributions when 600 and 1000 yards were used as the longer runs.

600–200 events, but that may have been due to the small number of cases (see Table 8 for 600–200 drop-off.)

At present the 600–200 combination is favored. It seems that drop-off should be a valuable score provided the runners can be made to do their best, especially upon the shorter run, and provided the ratios are such as to include the factors of speed and endurance mentioned above.

A comparison of the minimum expected scores (Table 4) with the most probable scores (Table 5) for the 600–60 combination indicates that the D index is less satisfactory than the Q index because the average scores are smaller than the minimum expected scores.

Sit-ups

Sit-ups were designed as an endurance test for the muscles of the trunk and legs. At first sit-ups and leg-lifts were used together, five of each alter-

nating and continuing as long as possible. The frequency curves were irregular, and a high percentage of both boys and girls were not able to score at all. Some of the huskiest boys who had short legs could not sit up when their legs were free. On the basis of these facts, this test was rejected in favor of the one described below.

The testee lies in a prone position on his back. Then, with his fingers laced behind his neck and with his partner holding his heels down, he sits up as many times as possible. On the first sit-up, he touches his left knee with his right elbow; on the next, his right knee with his left elbow. He continues these movements, without stopping, for 2.5 minutes.

A few boys and a considerable number of the girls did not take this test. Whether they refused to take it or whether they attempted it but could not

TABLE 5

The drop-off indexes calculated from predicted scores for 600–60 yards for each age group of boys

AGE mo./10	PREDICTED SCORES		DROP-OFF	
	60 yd.	600 yd.	D	Q
115	.183	2.593	7.6	1.42
125	.176	2.541	7.8	1.43
135	.170	2.494	7.9	1.47
145	.165	2.398	7.5	1.45
155	.160	2.306	7.1	1.44
165	.155	2.205	6.6	1.48
175	.149	2.108	6.2	1.42
185	.145	2.026	5.8	1.40
195	.140	1.951	5.6	1.40
205	.136	1.912	5.5	1.40
215	.134	1.877	5.4	1.40
225	.132	1.853	5.3	1.40
235	.131	1.836	5.3	1.40
245	.130	1.825	5.3	1.40

score is not known. The accumulated frequency curves had short tails because of a concentration of scores at the lower ends. This made it seem that the test was still too difficult. Consequently, it was changed in 1950 by having the testee place his finger tips on his shoulders instead of lacing them behind his neck. A comparison of the two curves, shown in Figure IV, indicates that the second method was easier.

The age distributions for the 1945–48 data were positively skewed. They were plotted on semilogarithmic paper, and from them standard scores were scaled. The log means and log standard deviations were calculated according to equations developed by Davies (3), but the tables are not given here. Standard score tables for the 1950 test will be calculated as soon as sufficient data have been accumulated.

The mean scores for age groupings for both the earlier and the 1950 tests showed increases which resembled a growth curve. Consequently, the iso-

TABLE 6

Quotient (Q) drop-off index for 600–200 yard combination

	−1.05	1.05	1.15	1.25	1.35	1.45	1.55	1.65	1.75	1.85	1.95	2.05	2.15	2.25	2.35	2.45	2.55	2.65	TOTAL
									Percent										
Boys	.4	2.9	9.3	24.0	30.5	19.1	4.9	4.5	1.6	.9	.2	.2	.4	.5	.2			.4	100.0
Girls	.8	1.6	4.7	12.2	16.6	23.7	17.9	9.9	3.9	4.1	1.6	1.1	.8	.5		.3			100.0

TABLE 7

Difference (D) drop-off index for 600–200 yard combination

	−.05	.05	.15	.25	.35	.45	.55	.65	.75	.85	.95	1.05	1.15	1.25	1.35
							Percent								
Boys	.4	1.3	2.0	5.8	12.2	16.7	20.4	16.0	10.0	6.5	2.3	2.0	.9	1.1	.7
Girls	.8	.6	.9	1.4	4.9	7.1	7.2	9.6	11.0	13.0	12.7	6.9	6.0	5.5	2.7

	1.45	1.55	1.65	1.75	1.85	1.95	2.05	2.15	2.25	2.35	2.45	2.55	TOTAL
						Percent							
Boys	.4	.4	.2	.5			.2						100.0
Girls	3.1	1.4	1.2	.6	1.6	.6	.3	.2	.3	.2		.2	100.0

TABLE 8

Average drop-off indexes by age groups for 600–200 combination

AGE IN MONTHS	D INDEX		Q INDEX	
	Boys	Girls	Boys	Girls
125	.65	.86	1.37	1.44
135	.67	.94	1.38	1.49
145	.63	.88	1.38	1.47
155	.63	.84	1.36	1.46
165	.52	.85	1.32	1.49
175	.55	.94	1.35	1.53
185	.55	.91	1.37	1.50
195	.48	.93	1.34	1.51
205	.55	.76	1.40	1.43
215	.52	.86	1.38	1.48
225	.60		1.46	
235	.51		1.37	

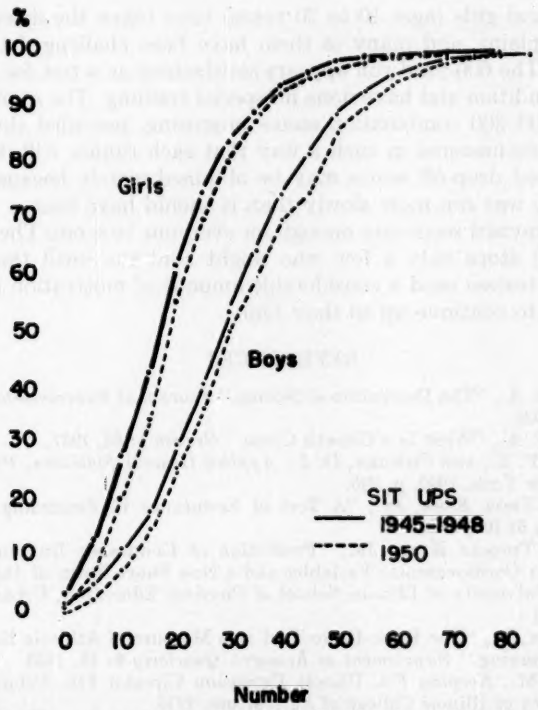

FIGURE IV. The accumulated percentage distributions of the harder (1945–48) and easier (1950) test.

chronic growth curve was calculated for the 1945–48 data. A satisfactory fit was found for the boys. The girls' curve was a poor fit. After 160 months

of age the girls' scores fell below the 120-month level. This result indicates a loss in strength and endurance of abdominal muscles as girls grow older. The growth curves for the revised test will be calculated as soon as sufficient cases have been tested.

Summary

Endurance activities are difficult. They take time, they make a person hot, sweaty, and breathless. But they promise great rewards in life-long fitness (8). Long-distance running is about the best kind of endurance-building activity there is, and every young person should do a lot of it. Many young people do not know this, and they can not therefore be expected to enjoy the benefits of endurance training unless their parents and leaders tell them about its advantages. Even though it is hard to do, boys and girls are challenged by it and seem to enjoy seeing their scores increase as the result of hard work.

4-H boys and girls (ages 10 to 20 years) have taken the described tests without complaint, and many of them have been challenged to improve their scores. The 600-yard run appears satisfactory as a test for those who are in fair condition and have done no special training. The quotient drop-off for the 600–200 combination seems promising, provided the 200-yard run can be administered in such a way that each runner will do his best. Otherwise good drop-off scores may be obtained merely because the 200-yard distance was run more slowly than it should have been.

Sit-ups as revised seem easy enough for everyone to score. The time limit (2.5 minutes) stops only a few who might continue until they suffered cramps. The testees need a considerable amount of motivation in order to induce them to continue up to their limit.

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Practice Effect of Non-Dominant *Vs.* Dominant Musculature in Acquiring Two-Handed Skill[1]

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Introduction

In the teaching of new skills which require the use of both the dominant and the non-dominant musculature, most coaches and physical education teachers begin by teaching a particular skill to the dominant musculature first with attention given to the non-dominant musculature later. Would it not be just as good, or better, to begin with the non-dominant musculature first? It is the purpose of this study to give at least a partial answer to this problem by revealing the practice effects of using the non-dominant versus the dominant musculature in acquiring two-handed skills.

In 1844, E. H. Weber (15) observed that some children trained to write with the right hand were able without further training to produce very good mirror writing with the left hand. Fechner (15) in 1858 reported that a professor in surgery found, in teaching certain delicate operations that must be performed sometimes with one hand and sometimes with the other, that it was more economical to train his students only in the use of the left hand, because the right hand, without further training, would take over the skill. Later on, Scripture, Smith and Brown (10) found that practice of the right hand in pressing a dynamometer resulted in an apparent gain of strength of the left hand. Swift (11) observed in 1903 that ball tossing showed transfer from the right hand to the left in five out of six subjects tested. In a problem utilizing transfer, Munn (8) found a reliable gain to be secured by an experimental group that practiced a skill with the right hand, taking the final test with the left hand; as compared to a control group which took the final test with no practice intervening.

Travis and Herren (12) in 1929 studied antitropic movements of the hands of stutterers and found that, when the attempt was made to move both hands in opposite directions at exactly the same time, the non-dominant member led the movement more frequently—they felt because it received over-attention. Through the use of action currents, Milton and Warren (7) a few years later found that in simultaneous movements of the fingers, both action currents and movements were stronger in the hand not used in writing. Orton and Travis (9) learned that in right handed normal

[1] From the Research Laboratories of the Department of Physical Education, University of California, Berkeley. The writer is indebted to Franklin M. Henry for advice and criticism during the course of this research.

speakers, during the simultaneous flexion of the digits of the two hands, action currents tend to arrive first in the right forearm of a majority of the subjects. That precedence of lead in simultaneous contraction of homologous groups is determined largely by instructions given was contended by Tuttle and Travis (13).

About the same time, Vogel (14) discovered that experimentally right-dominant individuals both throw and bat right-handed; but that experimentally left-handed individuals show mixed performances with the right hand being preferred. Irwin (4) using the order of response test with two members of the body responding by simple flexion movement, observed a close agreement between subject's statements of handedness and actual performance, with the reverse being true concerning the feet.

In all of the above mentioned experiments it is seen that there is agreement in the belief that bilateral transfer of skills from one bodily member to another actually occurs. However, no studies were found which directed attention toward discovering which is the more important musculature to train in acquiring two-handed skills. The purpose of this investigation is, therefore, to determine which is the more efficient method: teaching the subject to master the use of his non-dominant musculature first with instruction given to his dominant musculature later, or teaching him to use his dominant musculature first and then his non-dominant musculature.

Apparatus and Procedure

The test consists of a peg board in which two identical patterns of pegs are placed opposite to each other. The far pattern is viewed through a mirror, direct vision being obscured by a ply-wood shield (Figure I). Other instruments used included a stop watch which was capable of recording time in tenths of seconds and a key-operated light which was found to be necessary in order to standardize the hand movements of each subject. The use of this key will be explained later.

Several preliminary studies with subjects not included in this investigation showed that certain peg patterns were more difficult than others. The final pattern (to be described later) was chosen for its limited amount of mental effort and for its comparative maximum amount of motor manipulation. Using this pattern, it was possible to show a significant amount of learning in a comparatively short space of time. It was also found in preliminary experiments that the mirror phenomenon in learning a motor skill produced a high initial error, decreasing fairly rapidly in the first few trials and showing a slow improvement after the first 10 trials. This was in agreement with the Bray (1) experiment. Bray found that the transfer effect is not altered by extending the testing period. Also he found that most of the transfer took place during the first few trials.

The subjects used in the present investigation consisted originally of 70 male students selected from a fraternity population on the University of California campus. Since these men were picked alphabetically from a fraternity roster, it is not unreasonable to assume that the subjects may be

considered a random sample of this fraternity group. Where medical records indicated physical disabilities of any type, the individual in question was excluded from participating in the experiment. The group was heterogeneous from the point of view of socio-economic status (varying from self-supporting to wealthy) and attitudes in motor skills, but was relatively homogeneous with respect to the number of years of school experience and intelligence.

The next step was to determine the degree of handedness of these subjects. This was done by a simple handedness questionnaire. First, it was

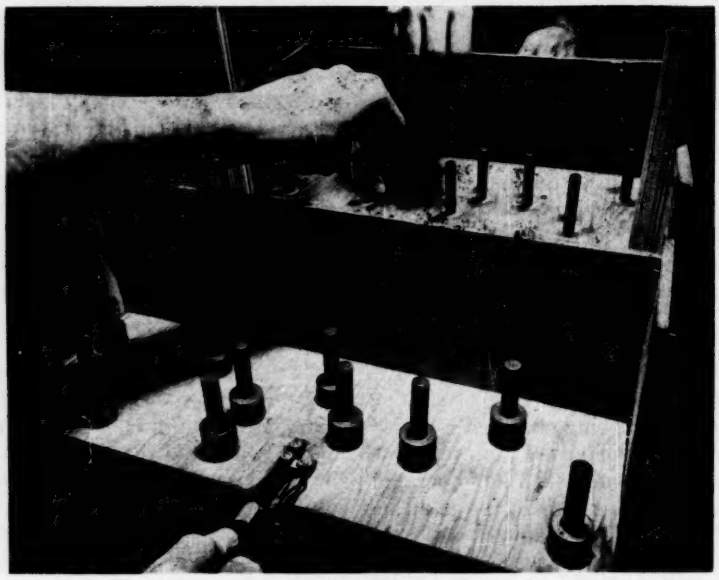

FIGURE I. Psychomotor test

Two sets of 10 pegs separated by a vertical plywood shield. The subject, due to his position, sees only the mirror image of the pegs behind the shield.

intended that several objective tests would be employed to accomplish the above. However, this idea was discarded after putting the first five subjects through some simple objective tests, such as asking each subject to throw a ball, write a note, hammer a nail etc. and later requiring them to fill out the handedness questionnaire. In every case the two measures coincided. While it must be conceded that this was a small sample for validity—establishing purpose, the handedness questionnaire was used thereafter in order to save time. Twenty subjects of the original sample of 70 had a considerable degree of ambidexterity, so they were not used in this experiment. The 50 subjects that remained were split into two smaller groups which were labled group A (non-dominant) and group B (dominant). In

each of the two groups only one left handed person was used. This precaution was taken because an experimentally lefthanded individual is more likely to show mixed performances than an experimentally right-handed person (Vogel, 14). Each subject was then given Test 1.

The subject sat in front of the Psychomotor Test in such a way as to enable him to see the pegs on the opposite side of the shield reflected in the mirror, but not directly. He then placed both of his index fingers on the key which pressed down to turn off a small light. After an auditory stimulus, which consisted of the click of the stop watch starting the mechanism, he proceeded on a set pattern of movement sequences which had been described to him to his complete satisfaction. The unused hand was kept on the key. The movements of the hands consisted of first picking up, with the

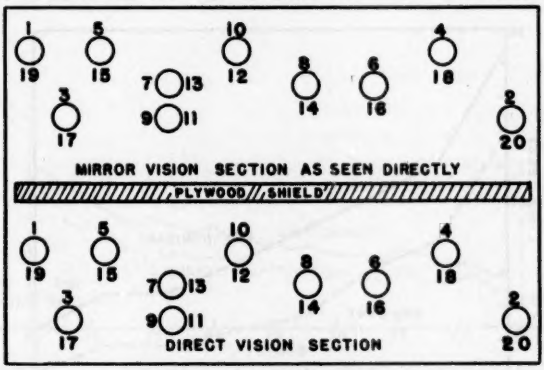

FIGURE II. Test movements

Sequence of movements in Psychomotor Test. Odd numbers are left-hand movements while even numbers are right-hand movements.

left hand, the top washer from a stack of 12 washers located on the left initial peg, and placing it on a corresponding peg which the subject viewed in the mirror. Then this hand was returned to the key and the right hand used to pick up the top washer from the right side initial stack of 12 washers, moving this washer to a corresponding peg viewed in the mirror.

For the third movement, the top washer of 12 on the second left peg was picked up and shifted; for the fourth movement, the top washer of the second right peg was shifted. The two hands continued these operations alternately, until 20 washers had been shifted from front to back, *i.e.* two of the 12 washers on each peg were shifted to the corresponding peg as shown in Figure II. Thus the first trial of the first period consisted of 20 movements by both hands or 10 with each. The time for this task, in tenths of seconds, was recorded for each subject. Five trials constituted a period.

After completing Test 1, the subjects were given eight periods of practice. Group A (the non-dominant hand group) practiced with their non-

dominant hand while group B (the dominant hand group) practiced with their dominant hand. The practice periods consisted of runs similar to Test 1 except that only the one hand (10 movements) was used. Thus, if the subject's right hand was dominant and if he was placed in the group that practiced with the dominant hand, he would begin at the far right peg (Figure II) and progress across the board until he completed the desirable movement at the far left peg.

All subjects were treated alike with respect to preliminary instructions. The tests were given in a room free from distractions and in which there was good light and ventilation at all times. Each subject was tested individually. In order to avoid fatigue, there was a rest period of 24 hours before the next practice trial was permitted. All practice trials for each subject occurred at a consistent time of day. At the close of the practice

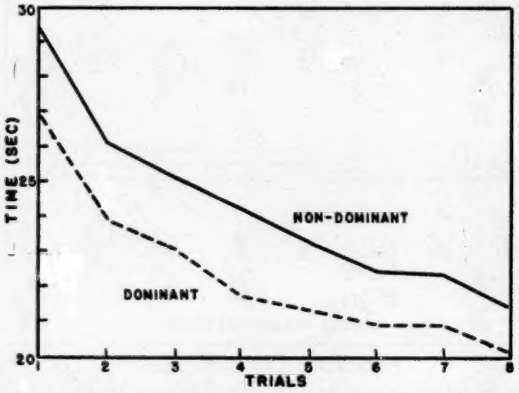

FIGURE III. Learning curves for the psychomotor test

Non-dominant group using non-dominant hand shown by solid line; dominant group using dominant hand shown by dashes.

sessions, both groups were given Test 1 again under the same conditions as for the first test.

Discussion of Data

In the present study, it was essential to know whether the two groups showed a statistically significant difference in performance at the time of their first test. It was found that the difference between the two groups was no larger than would be expected from two random samples of the same population, as the "t" ratio was only 0.80. For this reason, further equating of the two groups was unnecessary (6).

During their practice periods, the scores of both group A and group B revealed typical learning curves (see Figure III). Upon completion of their practice periods, both groups disclosed statistically significant learning. (For group A, $t = 16.0$; group B, $t = 13.6$). The initial errors seemed to

have to do with the subject's adjustment to the reversing effect of the mirror. At the beginning of the practice trials, the subject's placement of the washers on the pegs seemed to be a matter of chance. The second response invariably carried the subject farther away from the peg. Next to the difficulty in adjusting to the mirror phenomenon was the ability to correct by the proper amount. Over-correction seemed to be the tendency.

The elimination of errors of direction and of correction was due, in part at least, to the development of "schemes." The majority of the subjects reporting "schemes" found it best to correct an error kinesthetically. Visual perception of errors played little part in this process, being used only to determine the existence and amount of error but not direction. Although a

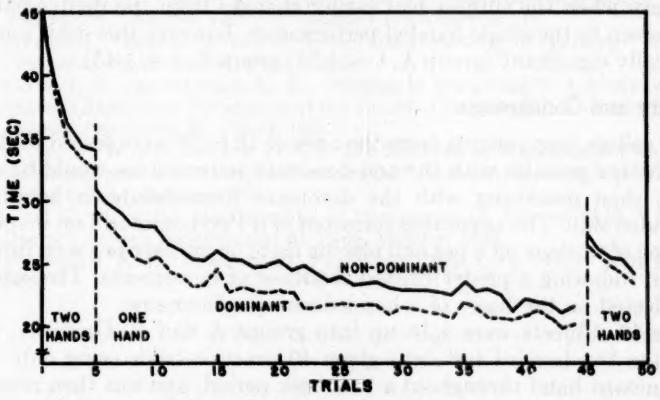

FIGURE IV. Two-handed vs single-handed performance on psychomotor test
Non-dominant group using non-dominant hand shown by solid line; dominant group using dominant hand shown by dashes.

few of the subjects at the beginning of their practice period used the kinesthetic scheme, they usually found it to be ineffective as time went on and discarded it.

Further inspection of the curves suggest that the non-dominant hand, which of course was less accurate at the beginning, showed a greater amount of improvement in learning than did the dominant hand. However this suggested difference was later statistically evaluated and was found to be statistically non-significant ($t = 1.68$).

The answer to the question, would it not be more efficient, in learning two-handed skills, to practice non-dominant hand rather than the dominant hand, was found to be in the negative. In the above type of performance, the method of practicing the non-dominant hand first showed no significant difference over the method of practicing the dominant hand first ($t = 1.04$). This result was obtained by comparing the two-handed learning scores of group A with those of group B. While it is true that a larger number of cases might have revealed a significant difference in practicing the non-

dominant hand first, the observed difference was so small that it is questionable if any important effect would be found with a larger sample.

After the switch from the single-handed performance to the double-handed performance, a loss of efficiency of the practiced hand was noted (see Figure IV). This loss of efficiency seemed to be due to a sort of interference with the normal type of hand movement, a type of retroactive inhibition. This interference was statistically evaluated and it was found to be highly significant (group A, t = 9.0; group B, t = 8.8). After this initial interference, the double-handed performance shows rapid improvement and within five trials nearly regains its loss in efficiency.

Further inspection of the curves shows that a decided drop in scores also took place when the subject had earlier changes from the double-handed performance to the single-handed performance, however this drop was not statistically significant (group A, t = 1.35; group B, t = 1.45).

Summary and Conclusions

Fifty college men ranging from the ages of 19 to 25 were tested to determine whether practice with the non-dominant musculature would be more efficient than practicing with the dominant musculature in learning a two-handed skill. The apparatus consisted of a Psychomotor Test involving the lifting of washers off a peg and placing them on another peg seen through a mirror, following a predetermined sequence of movements. The subjects were selected on the bases of a handedness questionnaire.

These 50 subjects were split up into groups A and B. Group A, after taking the two-handed test, was given 40 practice trials using only their non-dominant hand throughout a two week period, and was then retested. Group B, after a similar initial test, had the same number of practice trials using the dominant hand and also received a retest.

1. Although the learning curves suggest that more learning took place in the non-dominant group than in the dominant group, the difference is not statistically significant (t = 1.68).

2. There seems to be little difference as to which hand is trained first in learning a two-handed skill, for the difference in two-handed learning scores between group A and group B was not significant (t = 1.0).

3. An interference effect resulting in poorer performance, was found to result from switching from the single-handed performance to the double-handed performance. This interference was found to be statistically significant (group A, t = 9.0; group B, t = 8.8). This suggests that the most efficient method of training might be to give equal attention to both musculatures at the same time, rather than practicing first with either the dominant or the non-dominant hand.

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An Experiment in Homogeneous Grouping and Its Effect on Achievement in Sports Fundamentals

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PROFESSIONAL school authorities have continued to cite the need for a more refined grouping of students. To individualize instruction and to reduce the heterogeneity within groups, various plans of homogeneous classification based upon some degree of similarity among individuals have been advocated. The usual plan is some form of ability grouping.

The famed Winnetka plan (3), the X-Y-Z plan of Detroit (2), Martin's study at the junior high-school level (1), and the numerous experiments of Billett (1) are well-known typical examples of the experimental use of homogeneous groupings in the academic fields. It appears that the slowest students are most helped by such groupings. Differing results have been obtained regarding the comparative values which might accrue to bright students.

The possible values to be gained from ability grouping in physical education include the increased individualization of instruction, the equalization of teams for competitive purposes, and the achievement of higher pupil performance levels.

Recognition of the desirability of ability grouping in physical education is indicated by the large number of proposed tests of motor ability and educability and by efforts to propose practical classification and sectioning devices.

Purpose

The purpose of this study was to determine the effects of ability grouping on the motor performance of freshmen women students enrolled in sports fundamentals classes at the University of Nebraska.[1] It is recognized

[1] A course in the fundamentals of sports, emphasizing especially the running, throwing, and jumping skills, is required of all freshmen women at the University of Nebraska. This course is considered important for these particular students since a great number of them enter the University of Nebraska with meager training in physical education activities. The students engage in this course for a period of nine weeks. Classes meet twice weekly with an instructional period of 35 minutes.

that it is not frequently possible to schedule classes so that every student is placed according to ability. The present study was concerned with the worthwhileness of scheduling special sections for only those students whose ability is significantly higher or lower than the average.

Procedure

At the beginning of this investigation, a group of approximately 400 freshmen women was given the Scott Motor Ability Test (4), a battery including an obstacle race, basketball throw for distance, and standing broad jump. A list was compiled of those whose performances on this test placed them in the upper or lower 25% of the group. Two special sections of sports fundamentals were scheduled, one each for the lowest and highest ranking groups. These students were asked to enrol in the appropriate special section; other students were excluded. The expectation that only approximately 50% would be able to meet at the scheduled hours was shown to be the case by subsequent enrolment. There were 46 students enrolled in each of the special sections. The enrolment of the remaining group of 34 superior and 44 inferior performers scattered these students at random throughout the additional seven sections of regular sports fundamentals classes; these students formed the control groups.

The exact content of the course was carefully planned so that all students would receive identical instruction in so far as this was possible. The two instructors in charge of the special superior and inferior groups were also among the regular section instructors. All instructors involved used the same course of study, outlined in detail with reference to content and opportunities for guided practice. The lessons included considerable attention to the mechanical principles involved in handling the body and practice in such basic sports activities as body balance, locomotion, throwing, catching, jumping, landing, and striking. The factors upon which speed, accuracy, and force are dependent were studied. Provision was made for students to experience handling various types of sports equipment and to participate in games and relays. The Scott Motor Ability Test was repeated in all classes at the end of the course.

Results and Discussion

As may be seen in Table 1, there was no initial difference of significance between the performance of the experimental and control superior groups. The null hypothesis is tenable at the 1% level of confidence and the groups were therefore considered matched before the experiment started.

The mean gain of the superior groups was compared at the end of the experiment. The skill improvement made by the experimental class was decidedly greater than the improvement shown by the control group of superior students. The results are tabulated in Table 2. It was considered unnecessary to use a formula for matched individuals, man-to-man. Had such a formula been applied, the results would have appeared statistically

even more significant, and with an uncorrelated group formula the results indicate a highly significant difference in improvement at the 1% level of confidence.

Table 1 shows the comparative initial performance of the inferior groups. The mean performance score of the inferior performers enrolled in the special class was matched by that of the inferior performers in the control group

TABLE 1

Comparison of initial motor performance test scores of experimental and control groups of superior and inferior skill

	SUPERIOR GROUPS		INFERIOR GROUPS	
	Control	Experimental	Control	Experimental
N	34	46	44	41
M	175.80	173.70	112.89	111.80
SD	12.40	12.00	9.90	8.85
σM	2.12	1.80	1.49	1.36
σD	2.79		2.01	
t at the .01 level	±2.65		±2.65	
obtained t value	.75 (not significant)		.54 (not significant)	

TABLE 2

Comparison of mean gains in motor performance of experimental and control groups of superior and inferior skill

	SUPERIOR GROUPS		INFERIOR GROUPS	
	Control	Experimental	Control	Experimental
N	34	46	44	41
Final M	188.80	200.80	147.05	145.07
Mean gains	14.00	27.08	34.86	33.18
SD gains	12.15	15.24	12.96	13.08
σM gains	2.11	2.28	1.98	2.06
σD	3.10		2.81	
t at the .01 level	±2.65		±2.65	
obtained t value	3.87 (significant at the $<.01$ level of confidence)		.59 (not significant)	

scattered throughout the remaining classes. The null hypothesis was found tenable at the 1% level of confidence; the two groups showed no significant difference in performance at the beginning of the study.

At the end of the investigational period, the experimental and control groups of inferior performers were compared. As may be seen in Table 2, there was no significant difference between the final performances of these groups. The mean gains were approximately equal, the difference being so small as to be attributable to chance. Test scores of the experimental class of inferior performers were not influenced by segregation.

In planning this experimental study, it was recognized that segregation

of highly and poorly skilled students might lead to changes in pupil attitudes toward the physical education work. Since the investigation was directed primarily toward the observation of changes in motor performance, no attempt was made to measure attitudes. However, as a matter of interest, students in the experimental classes were asked at the end of the course to record their reactions to having participated in a special class.

TABLE 3

Sample expressions of student reaction to membership in a homogeneous group

SUPERIOR GROUP	
1.	I like the special class as it gives incentive to try harder and makes the class much more interesting.
2.	The whole group was more skilled, quicker to respond, and more interested.
3.	I have enjoyed this class because everyone had approximately the same abilities.
4.	It is more fun and you seem to accomplish more when no one is holding the class back. There seems to be more spirit and competition too.
5.	I have been attempting to improve rather than remain the same as I would have if I had been in a slower class.
6.	Everyone has about the same abilities and it is more fun that way.
7.	I like working with girls who have high ability. I like to play when there is real competition.
8.	It gave you an incentive to work harder—competition.
9.	I felt it was impossible to excel and I was discouraged.
10.	There is more incentive to do your best when everyone else is doing well. Games more interesting.
INFERIOR GROUP	
1.	I will try harder since I don't feel as though I'm making a fool out of myself compared to those who are a lot better.
2.	In this class, I don't feel so inferior or unable to do things.
3.	The class doesn't seem to advance so fast that one can't keep up.
4.	It builds self-confidence in playing with those who are nearer my equal.
5.	All the individuals are on the same ability level. All join in the work where in a class of mixed abilities the more talented do all the work.
6.	It makes little difference to me one way or another.
7.	I find more incentive to improve when working with those better than myself. One observes from more skilled students.
8.	I feel we get more help on the various skills. I felt better working with girls with more my ability.
9.	I feel the girls are more of my own standing and the competition is not so keen.
10.	No one feels very self-conscious, more at ease.

Comments were submitted unsigned and effort was made to assure the students that criticisms as well as approval would be most welcome.

Samples of typical comments in the students' own words are listed in Table 3. In general, the replies expressed approval in both experimental classes. All but one subject, 98% of the superior group, preferred to be segregated. They felt that keener competition, enthusiasm of classmates, and opportunities for more advanced work had made the course more interesting than it would have been in a more heterogeneous group. Actually, the comment pertaining to advanced work was not based on fact, for all classes were held to the same course of study.

Eighty-eight percent of the poorly-skilled experimental class commented favorably on the special classification enrolment system. These students felt less self-conscious in a group of similar ability. Some thought there was more opportunity for individual help and for practice than would have been the case in a regular class where skilled performers would have taken over more than their share of the activity. Other comments included satisfaction at lessening of competition. It is possible that the element of competition for grades may have been the factor referred to in some of these comments. Students may not have been aware that their scores on the motor ability test were graded by norms set up over a period of several years and based on over 1000 scores. Six percent of the inferior performers indicated that the presence of the better skilled performers in a regular class would have motivated them. In this group they were not thus stimulated. Six percent of the inferior performers revealed indifference as to type of class in which they preferred to be enrolled.

Summary and Conclusions

Freshmen women at the University of Nebraska were classified according to the Scott Motor Ability Test. Two special sports fundamentals classes, one for superior- and one for inferior-ranking performers were set up. Approximately 50% of the highest and the lowest-scoring students enrolled in the appropriate special class sections. The remaining 50% served as control groups and were distributed among seven regular sports fundamental classes.

The Scott Motor Ability Test was repeated at the end of a nine-week, two periods a week course in the skills and body mechanics common to various sports.

An effort was made to determine the effect of class enrolment by an ability classification system upon motor performance of highly and very poorly skilled students.

The superior performers benefited to a statistically significant extent by being segregated. Scores of inferior performers were not influenced by membership in a special class. Written comments of both experimental classes indicated that the great majority preferred to enrol in a sports fundamentals class limited to persons of similar ability.

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The Wetzel Grid as a Performance Classifier with College Men

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THE WIDESPREAD belief that physical education has an important contribution to make toward normal growth and development has led many people in the field to a consideration of the problems involved in the determination of growth status.

In recent years, there has been a sound trend for efforts of this nature to remain in the province of the pediatrician and the growth and development specialist. At the present time, it seems pertinent, nevertheless, to submit a brief consideration of certain proposed applications of the currently popular Wetzel Grid which have been directly related to the physical education program.

In a recent study, Grueninger concluded that the grid technique provides an effective grouping of high-school boys and college men in terms of motor performance.[1] Since performance classification of college men, based upon height and weight factors, has been long sought after with but little success, Grueninger's report has aroused considerable interest, and some skepticism, among physical educators. The purpose of this paper is to present additional evidence—through a further consideration of the original data—on the adequacy of the Wetzel Grid in providing such a classificatory device.

Background

Wetzel has found that growth for healthy children of a given body type follows a pattern with a high degree of fidelity, and the grid technique is a method of predicting the expected growth of any child from his own pattern. Wetzel's work is based upon the assumption that growth is an indication of general health status, and that adverse changes in environment can disturb this development long before the appearance of definite anomalies. Thus slight deviations indicated on a child's grid record can be of help to the physician in assessing growth progress.

The Grid itself is composed of graphs upon which height, weight, and age data are plotted. One of the graphs is transversed by seven diagonal channels which represent various body types (physique) ranging from obes-

[1] Robert M. Grueninger, *Physical Performance of High School Boys and College Men Classified by the Grid Technique*. Microfilmed doctoral dissertation, Ann Arbor: University of Michigan, 1949.

ity to malnutrition. These channels are crossed obliquely by lines of developmental level representing body surface area (body size). Height and weight are plotted on this graph, and determine body build and developmental level by position. A second graph uses chronological age for the horizontal axis, and developmental level for the vertical axis. Curves on this graph called "auxodromes" indicate various schedules which children follow in their approach to maturity. The function of the channel graph is to determine direction of development, and that of the auxodrome graph is to determine speed of development. A major value of the graphs is that by their use each child becomes his own standard of comparison.

According to Wetzel, healthy growth is indicated by:

". . . development along a channel of given body type, on an age schedule or time table of progress specific for the subject, and with preservation of that subject's natural physique."[2]

The Wetzel Grid was designed to aid the physician in measuring and appraising the growth of children, and although some phases of the technique have been questioned, it has been described by Brody as having provided ". . . the best expression to the weight-height-age status."[3]

Shortly after the introduction of the Grid, Grueninger became interested in the possibility of using the mechanical aspects of this technique as a means of classifying men into homogeneous groups for investigations of motor performance.

The feasibility of using the technique with college men was substantiated by direct application to a company of aviation cadets in training at Western Reserve University during the early war years. This preliminary study confirmed Wetzel's findings that classification by channel corresponds to recognizably different physique types, and that level values represent body size independent of physique.

The major effort of Grueninger's work was to analyze various motor performances in terms of the influence exerted by the variables of body build and size. Twelve tests were arbitrarily selected with the attempt to provide a battery involving elements of strength, agility, power, endurance, and speed. These items included: (a) 10-second Burpee, (b) 60-second Burpee, (c) dodging run, (d) 440-yards run, (e) grip strength, (f) parallel bars dips, (g) pull-ups, (h) push-ups, (i) Sargent jump, (j) sit-ups, (k) squat jumps, and (l) standing broad jump. These tests were applied to over 5800 men and boys.

Grueninger concluded that all of the tests—with the exception of grip strength—followed a common pattern in terms of physique and size relationships to performance.[4] Maximum performance was generally found

[2] Norman C. Wetzel, *Instruction Manual in the Use of the Grid for Evaluating Physical Fitness.* New York: NEA Service Inc., 1941, p. 1.

[3] Samuel Brody, *Bioenergetics and Growth.* New York: Reinhold Publishing Corporation, 1945, p. 638.

[4] Grueninger, *op. cit.*, Chapter 7.

in physique channels A1 or A2, with a regular decline in channels removed from these classes. In the case of body size, performance increased regularly up to approximately level 170, and dropped off from this point despite further level increases. Grip strength differed from the other test items studied in that no maximum was indicated in connection with level. This item did, however, conform to the physique pattern found for the other tests.

In addition to the data secured on performance in motor activities

TABLE 1

Standard errors of the differences between adjacent means of Wetzel physique channels in seven performance tests

CLASS	MEAN	DIFFERENCE BETWEEN MEANS	STANDARD ERROR	CLASS	MEAN	DIFFERENCE BETWEEN MEANS	STANDARD ERROR
Pull-ups				Sargent jump			
A1	8.47			A1	20.31		
M	8.33	.14	.19	A2	20.22	.09	.61
M	8.33			A2	20.22		
A2	8.32	.01	.23	M	20.14	.08	.19
A2	8.32			M	20.14		
B1	7.90	.42	.24	B1	19.88	.26	.17
B1	7.90			B1	19.88		
A3	7.36	.54	.32	B2	19.70	.18	.24
A3	7.36			B2	19.70		
B2	7.17	.19	.35	B3	19.54	.16	.50
B2	7.17			B3	19.54		
B3	6.89	.28	.48	A3	19.40	.14	.51
B3	6.89			A3	19.40		
A4	6.02	.87	.57	A4	18.62	.78	.45
Push-ups				440-yard run			
A2	27.23			B2	70.99		
A1	25.56	1.67	1.21	M	71.52	.53	.89
A1	25.56			M	71.52		
M	24.54	1.02	.71	B1	71.55	.03	1.00
M	24.54			B1	71.55		
A3	24.09	.45	1.46	A1	71.61	.06	1.00
A3	24.09			A1	71.61		
B1	24.01	.08	1.52	A2	72.33	.72	.80
B1	24.01			A2	72.33		
A4	21.79	2.22	1.53	A3	74.29	1.96	1.04
A4	21.79			A3	74.29		
B2	20.99	.80	1.61	A4	75.50	1.21	1.89

TABLE 1.—*Continued*

CLASS	MEAN	DIFFERENCE BETWEEN MEANS	STANDARD ERROR	CLASS	MEAN	DIFFERENCE BETWEEN MEANS	STANDARD ERROR
Grip strength				Standing broad jump			
A1	244.17			A2	85.61		
A2	239.35	4.82	2.80	M	85.14	.47	.69
A2	239.35			M	85.14		
M	235.94	3.41	2.71	A1	84.88	.26	.58
M	235.94			A1	84.88		
B1	229.89	6.05	2.51	B1	84.22	.66	.66
B1	229.89			B1	84.22		
B3	227.91	1.98	6.50	B2	84.00	.22	.80
B3	227.91			B2	84.00		
A4	225.35	2.56	7.53	B3	82.37	1.63	1.46
A4	225.35			B3	82.37		
A3	221.84	3.51	5.55	A3	82.20	.17	1.54
A3	221.84			A3	82.20		
B2	221.64	.20	4.48	A4	79.88	2.32	1.44

CLASS	MEAN	DIFFERENCE BETWEEN MEANS	STANDARD ERROR
10-second Burpee test			
A2	6.72		
A1	6.65	.07	.07
A1	6.65		
M	6.58	.07	.06
M	6.58		
B1	6.56	.01	.07
B1	6.56		
A3	6.56	.00	.09
A3	6.56		
B2	6.39	.17	.11
B2	6.39		
A4	6.39	.00	.13
A4	6.39		
A5	6.25	.14	.22

as defined by the 12-item battery, Grueninger also made a survey of high-school, college, and professional athletes participating in 11 different sports.

This investigation verified the empirical knowledge of the experienced

athletic coach that varieties of body shape and body size are factors highly associated with performance in different sports, and with specific team position in any particular sport. To such general information, this study adds data indicating that both physique and body size, as designated by grid channels and levels, modify performance sufficiently to require separate allowances for their effects.

Critique

The data presented by Grueninger clearly indicate that the Wetzel Grid is an extremely useful device for grouping men and boys into homo-

TABLE 2

Standard errors of the differences between adjacent means of Wetzel classification groups in pull-up test

LEVEL 135–144			LEVEL 155–164			LEVEL 175–184		
Class	Difference between means	Standard error	Class	Difference between means	Standard error	Class	Difference between means	Standard error
M			A1			A1		
B3	.41	.87	A2	.56	.68	A2	.14	.42
B3			A2			A2		
B1	.90	.75	M	.18	.62	M	.21	.43
B1			M			M		
B2	.21	.61	A3	.09	.82	B1	.20	.49
B2			A3			B1		
A1	.21	.79	B1	.62	.83	B3	.47	2.35
A1			B1			B3		
A2	1.75	1.19	A4	.56	1.31	B2	.29	2.43
A2			A4			B2		
A4	1.63	1.95	B2	.09	1.32	A3	.00	.81
A4			B2			A3		
A3	.62	1.74	B3	.81	.68	A4	.67	.62

geneous classes with reference to height-weight factors. Apparently, this technique provides distinctions of body size and build with a degree of fidelity not found in earlier classification schemes. However, whether mere refinement in the utilization of the same variables used in other grouping methods will provide significant improvement in performance classification seemed questionable.

In an effort to ascertain the effectiveness of the Grid for such use, certain of Grueninger's data were analyzed from a different point of view than he had used. Since six of his 12 test events were similar in nature to the University of Michigan war-time physical-fitness test battery, data from these particular items were selected for the critique with the thought of

possible future comparative studies in mind. The tests chosen for investigation included: (a) pull-ups, (b) push-ups, (c) grip strength, (d) Sargent jump, (e) 440-yards run, and (f) standing broad jump. As Grueninger had broadly grouped his battery of activities under four major headings—*strength*, *power*, *endurance*, and *agility*—data from a seventh event, the 10-second Burpee test, were added to the analysis in order to have at least one item from each larger classification.

The selected performance data were already grouped in terms of physique channels, and also in terms of both large and small ranges of body size levels.

TABLE 3

Standard errors of the differences between adjacent means of Wetzel classification groups in 10-second Burpee test

LEVEL 135–144			LEVEL 155–164			LEVEL 175–184		
Class	Difference between means	Standard error	Class	Difference between means	Standard error	Class	Difference between means	Standard error
B3			A1			A1		
A2	.08	.49	A2	.06	.14	A2	.03	.12
A2			A2			A2		
B1	.08	.44	M	.15	.15	M	.02	.13
B1			M			M		
A3	.04	.90	A3	.05	.20	B2	.10	.19
A3			A3			B2		
M	.06	.91	B1	.07	.21	A4	.02	.24
M			B1			A4		
A1	.15	.29	A4	.00	.34	B1	.02	.22
A1			A4			B1		
B2	.09	.30	B2	.03	.35	A3	.10	.18
B2			B2					
A4	.00	1.30	B3	.04	.29			

The first phase of the investigation was a consideration of the seven chosen events ranging through the body size levels 155–184.

The performance means of the physique channels were ranked for each of the seven tests, and the standard errors of the differences between adjacent means were calculated. Of the 47 pairs of means thus treated, there was no case in which the difference between any two bordering means proved significant (Table 1).

A further breakdown of the data was attempted by calculating the standard errors of the differences between means of narrower ranges of body size than that previously considered. For this investigation, three test—pull-ups, 10-second Burpee, and standing broad jump—were selected from the 12-item battery. These particular items were chosen on the basis that each is considered to be a measure of a highly specific factor of physical ability.

TABLE 4

Standard errors of the differences between adjacent means of Wetzel classification groups in standing broad jump test

LEVEL 135–144			LEVEL 155–164			LEVEL 175–184		
Class	Difference between means	Standard error	Class	Difference between means	Standard error	Class	Difference between means	Standard error
B3			M			B2		
M	1.6	1.82	A1	.7	.98	A2	.5	2.03
M			A1			A2		
B1	1.0	1.63	B2	.0	1.16	B1	.2	1.91
B1			B2			B1		
B2	.2	1.53	B1	.2	1.08	A1	.7	1.85
B2			B1			A1		
A1	1.5	2.07	B3	1.3	1.49	M	.1	1.19
A1			B3			M		
A2	.6	3.95	A2	.3	1.78	A3	3.3	1.44
A2			A2			A3		
A3	.8	5.22	A3	.6	1.98	A4	3.5	2.44
A3			A3					
A4	.4	5.56	A4	.4	2.22			

TABLE 5

Standard errors of the differences between adjacent means of Wetzel body size levels for three test items

PULL-UPS			STANDING BROAD JUMP			10-SECOND BURPEE		
Level	Difference between means	Standard error	Level	Difference between means	Standard error	Level	Difference between means	Standard error
165–174			175–184			125–134		
155–164	.11	.13	165–174	.55	.53	165–174	.01	.09
155–164			165–174			165–174		
175–184	.76	.18	155–164	1.17	.47	175–184	.10	.04
175–184			155–164			175–184		
145–154	.04	.21	185–194	1.41	.51	105–114	.01	.14
145–154			185–194			105–114		
185–194	1.43	.25	195–204	2.60	1.93	145–154	.02	.15
185–194			195–204			145–154		
135–144	.18	.30	145–154	.00	1.94	155–164	.06	.07
135–144			145–154			155–164		
125–134	.93	.32	135–144	4.50	.75	195–204	.00	.14
125–134			135–144			195–204		
195–204	.14	.40	125–134	3.30	.86	185–194	.08	.15
195–204			125–134			185–194		
115–124	.40	.47	105–114	2.90	1.40	135–144	.08	.11
115–124			105–114					
105–114	.10	.46	115–124	.30	1.60			

Each test was studied at three levels of body size—135–144, 155–164, and 175–184. As in the work with the wider range of size, however, there were no cases of significant differences between adjacent means (Table 2, Table 3, and Table 4). In the Burpee test, as a matter of fact, there was not a single difference between means at any of the three levels, which was greater than the standard error of the difference.

Despite the negative results of this study, graphic tabulation of the data revealed the trends of performance indicated by Grueninger. In a final attempt to substantiate the practical use of the grid technique as a means of classifying men for physical education activities, certain of the data were regrouped in terms of body-size level.

In this endeavor, the three test items of pull-ups, 10-second Burpee, and standing broad jump were again selected as being measures of quite different types of performance. Body-size classes were tabulated in terms of mean rank for all physique types, and the standard errors of the differences between adjacent means were calculated. Twenty-six pairs of bordering means were thus studied, but only four of these provided significant differences (Table 5).

Conclusions

Concerning the use of the Wetzel Grid as a classificatory device for use with college men, the following conclusions seem applicable:

1. The grid technique, in that it considers body size an important variable in addition to body type, provides an effective and efficient grouping of college men in terms of physical make-up dependent upon factors of height and weight.
2. In connection with motor performance, however, despite data showing apparent classification when presented in graphical form, in the scores re-analyzed there were no cases in which performance differences between adjacent channel means were statistically significant. This situation implies that the use of grid channels for performance classification is a very dubious procedure. Actually, even with maximum performance, which generally appears in physique channels A1 or A2, the small variances in the original data indicate little difference between channels A1, A2, M, and, probably, B1.
3. In a like manner, although maximum performance for all types of body build was found at a relatively constant body size, performance differences between adjacent means of various body size levels were generally not significant from a statistical point of view. As such, grid levels cannot be considered reliable in classifying for motor performance.
4. It has previously been suggested that the use of age, height, and weight variables do not adequately classify adult men in terms of physical achievement. The results of this critique indicate that refinements in the use of these factors make no further contribution toward such a specific purpose.

Relationship Between Observed Behavior in Elementary School Physical Education and Test Responses

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Purpose of the Study

This study will attempt to show the relationship between children's behavior in physical education, as revealed by anecdotal records of observed behavior, and their indicated responses to items on a paper-pencil test based on problem situations. Its purpose is to determine the relationship between actual reactions to situations and how children say they would react.

The hypothesis applied here was that there are no differences between observed reactions of children in actual situations and how they say they will react in similar situations as revealed by responses to a paper-pencil problem-situation test.

Need for the Study

An attempted revision of a test of Physical Education Knowledge and Attitudes used by one of the authors in a teaching situation led to an interest in measuring the extent to which the mental, emotional, and social objectives of physical education were met. It was discovered that no suitable test to measure these attitudes had been developed. Carpenter (3) says:

> "Lack of evidence, lack of analysis of our freely philosophized aims, lack of controlled research in regard to accomplishments of these aims. . . . There is need for truly scientific evidence that we accomplish even some of the things we claim we do. We are convinced that we achieve many of these purposes but what we need to produce is unquestionable evidence that such is the case."

Bontz (1) states:

> "Another area which has been sadly neglected is the field of research on the elementary level. . . . It should be possible to discover facts which could be used to substantiate our claims for contributing to the social and physical development of children."

Specifically this study is concerned with some of the objectives of physical education as set up for the Elementary Physical Education Program in Massena, New York. One of those objectives is: To develop the whole child physically, mentally, emotionally, and socially. This was used as a basis and guide to observations for judging favorable and unfavorable behavior. Realizing that any differences in attitudes of the individual when he pictures himself in a situation and when he is actually in that situation would shed important light on the problem of evaluation in physical education, this study undertook to develop a technique to observe and record behavior on the one hand and a situational paper-pencil test on the other.

Procedure Followed

The first step was to make up a test of situations which involved mental, emotional, and social responses. The situations were suggested mainly by actual happenings (observed behavior of students) in physical education classes. A series of questions was developed and listed under each situation, intended to indicate how the individual answering thought he would behave, or his attitude toward the situation. Each question could be answered "yes" or "no." There were 15 situations and a total of 90 test items. An example follows:

In gym classes one day we were having relays. For one relay, we had to hold our ankles and go as fast as we could to the wall and back to the team. Joe's team was winning but Joe wanted to go faster so he let his hands slide halfway up to his knees and ran in that position. Joe's captain saw him and told him to go again. We have a rule that a team is not finished until everyone on the team has done the relay correctly.

1. If you were Joe's captain, would you make Joe go again even if it meant your team would lose the relay? Yes☐No☐
2. If you were Joe, would you do what he did? Yes☐No☐
3. If you were on Joe's team, would you say that your team won when Joe finished the first time? Yes☐No☐
4. Did Joe help the other team win? Yes☐No☐
5. Was Joe doing his best for his team? Yes☐No☐
6. Should Joe tell his captain that he did not do the relay correctly if the captain did not see him? Yes☐No☐

The validity of this test was determined by an item analysis made from administering the test to 175 students in Grades III through VI in the Massena Public Schools who had received the same program in physical education, under the same supervisor, but were not included in this study. By comparing the 50 highest scoring students with the 50 lowest, the discriminating value of each item was determined. *The analysis was checked against the key for validity developed by Lindquist* (*8*). As a result of this analysis, items with low validity were revised.

The reliability of the test was determined by correlating the odd items missed with the even items missed. The coefficient of correlation was .815.

This test was administered to all students in Grades III through VI in Washington School in the Massena Public School System. To avoid interrupting the regular classroom schedule and to avoid fatigue on the part of the students taking these tests, it was administered in two parts. Each part required approximately 25 minutes to administer and could be completed in the regular physical education period.

From February through June, anecdotal records of incidents occurring in class were kept by the supervisor on 179 elementary school students in Grades III through VI in Washington School. These students met in physical education class three times a week for a period of 30 minutes. The classroom teacher who carried on the work of the supervisor for the third meeting of the class each week also kept anecdotal records of incidents occurring in the classroom. The pupils were not aware that a record of their behavior was being kept. During the entire year, as new terms and games were introduced, they were written on the blackboard to aid students in recognizing words on the written test.

An Anecdotal Summary Sheet was constructed to record observed behavior from the anecdotal records. The records were numbered and these numbers were entered on the summary sheet under the "yes" and "no" headings after each question which the anecdotal record answered or concerned. There were 56 significant questions, conveying the attitudes, beliefs, and behavior in each area, as nearly as could be determined. All but four of the questions checked "yes" denoted constructive achievement or positive behavior. Four of the questions are negative in nature when checked "yes" and positive when checked "no."

Following is a reproduction of a third grade summary sheet with 9 anecdotal records:

Mental	*Yes*	*No*
1. Does he accept suggestions, understand and follow directions well?	7	
2. Does he seem to know physical education rules?	4, 5, 8	
3. Does he obey them?		4, 5
4. Does he generally "stay with the group" mentally?	2, 4, 8, 10	
5. Is he persevering?	4, 5, 7, 10	
6. Is his reaction time average or better?	2, 5, 6, 8, 10	
7. Is he ready to try new activities on his own?	10	
8. Is he observing?	2, 4, 5, 7, 8, 10	
9. Does he use good judgement?	2, 8	2, 4
10. Does he accept responsibility?	6, 8, 10	4
Emotional		
1. Is he willing to accept consequences of his own acts?		5
2. Does he control his temper?		4, 2
3. Does he control his excitement in a close game?		
4. Is he usually happy?		
5. Is he sensitive?		
6. Is he free from jealousy of others' ability?		
7. Is he pleased with his own accomplishments?	7	
8. Is he modest?	9	7
9. Does he show respect for his leaders?	4, 8	
10. Is he honest with himself?	9	4, 5
11. Is he consistent in his reactions?		

Social	*Yes*	*No*
1. Does he have initiative?	4, 5, 6, 8, 10	
2. Does he feel secure in the group?	7, 8, 10	
3. Is he selfish?	5	
4. Is he generous?		
5. Does he have a favorable attitude toward the opposite sex?		
6. Does he laugh *with* rather than *at* others?		3
7. Can he give directions to the group so that they are accepted?		2
8. Does his group like him?		
9. Is he ready to do his share for his team?	2	
10. Does he encourage others on his team to work?		
11. Does he insist that others follow the rules?	10	
12. Is he courteous to other players and adults?	2, 4, 6, 8, 10	
13. Is he just?	2, 5	4
14. Does he take advantage of others?	5	
15. Does he show good sportsmanship most of the time?		2, 4, 5
16. Does he accept decisions of group and leaders?	5	4
17. Does he give and take in a friendly way?	6, 8	2, 4
18. Does he show sympathy to others in the group?	6	3
19. Does he show loyalty to others in the group?		2, 4
20. Is he overbearing in giving directions?	2	
21. Does he keep trying even if his team is losing?		
22. Does he do things to help the other team to win?		
23. Does he follow the rules even though no one is watching?		4, 5
24. Does he try to find ways of getting around the rules?	4, 5	
25. Is he kind to other players?		2, 3, 4
26. Is he fair to other players?	6	4, 5
27. Is he honest with other players?		
28. Does he take pride in his personal cleanliness?		

Following are the anecdotal records recorded on the preceding summary sheet:

2. Game—Change the Club. Squad leaders were asked to keep score also. Janet is second on Shirley's team, she too was keeping score, and she disagreed with Shirley. Shirley had the correct score having just checked with me. Janet said, "Oh, Shirley, you're so stupid you can't even count." Janet was cautioned to be careful. March 12.

3. Game—Change the Club. Billy fell when he returned to his place. Janet laughed loudly. March 19.

4. Janet was out of line watching Kangaroo relay. Helen told her to get in line. Janet hit Helen. Helen hit back. Janet said she wanted to watch the relay.

5. Game—Bombardment. Janet was hit, a few seconds after she was out she asked, "Teacher if the ball hit the floor and then hit my fingers would I be out?" I replied, "Janet you know that rule." She laughed. Janet asks this question every time we play this game. The first time I answered "no" and she dashed back into the game March 26.

6. At the end of the class, Janet was running back to her team. She bumped Nancy and knocked her down. Janet told Nancy she was sorry without being prompted. March 26.

7. Game—Baseball Target Throw. Janet has a well-coordinated throw which is swift and fairly accurate. Janet is proud of her throw and usually looked to see if she was being watched before she threw. April 27. (Note: The comment that Janet was proud of her throw should not have appeared on the anecdotal record. However, it is felt now that Janet was seeking attention.)

8. Relay was about to start under the direction of the Cadet Teacher. Janet

raised her hand and said "Teacher we forgot to count the number on our teams." May 2.

9. Grip Strength Test. Janet didn't do well the first time so I asked her to try again. I said, "You must be tired this morning." Janet said, "I was up till 10:30 last night." There was a music recital and Janet took part. June 4.

10. Skill Tests. Janet was not chosen to help. After the test started, Janet asked if she could help by keeping the teams in line. June 8.

Interpreting the Results

After all anecdotal records had been entered on the Anecdotal Summary Sheet, the number of entries was tallied, favorable minus unfavorable. While most of the totals thus derived were positive, a few were negative. One student had a minus total of 106. That amount was therefore added to all scores as a constant in order to make all derived indices positive to facilitate statistical treatment. The coefficient of correlation between the total test score and the total number of entries was .23. The median score on the problem-situation test was 80, and the median number of positive minus negative entries for each individual (corrected by 106) was 114.8.

The mental, emotional, and social scores for each individual were also determined. On the Anecdotal Summary Sheet, the total number of entries favorable minus unfavorable under each of the headings was tallied. To make all scores positive, a constant of 30 points was added to all mental scores, 24 points to all emotional scores, and 67 points to all social scores.

A jury of five experts, each working independently, was asked to make an item analysis of each question on the test, keying it to the question or questions on the Anecdotal Summary Sheet to which it pertained. The keys were then compared and any question which was keyed by three or more of the five members of the jury was used in the final key to determine each student's score on the written test under each heading: mental, emotional, and social.

The coefficient of correlation between the total entries under the mental heading on the Anecdotal Summary Sheet and the mental responses on the problem-situation test was .17; that of the emotional was .11; and that of the social was .17.

A comparison of mental responses on the problem-situation test and the mental entries of observed behavior on the Anecdotal Summary Sheet by distribution within intervals and means from interval to interval in double entry tables showed reasonable linearity and homogeneity of data.

Conclusions

On the basis of the evidence collected, the authors are not willing to accept the hypothesis. In fact, the data are such as to be stated most clearly in the converse. From the correlations, there is little positive relationship that one can accept with confidence between observed behavior and the pupil's responses to problem situation on a paper-pencil test. However, because all correlations are positive, though low, there is a slight relationship between children's observed behavior and how they say they will react in similar situations on a problem-situation test.

In the main, scores on the test were high. Therefore, most of the students know what is acceptable or constructive behavior. Students think they would make better adjustments than they actually do, although the observed behavior tends to run on the positive and constructive side.

In conclusion, it may be said that if one wishes to obtain a fairly accurate picture of how behavior of children relates to the objectives of a health and physical education program it is much better to observe and record behavior than to give a paper-and-pencil test, even though that test calls for responses to problem situations.

A carefully worked out guide for recording evidence on children's behavior, and especially the use of that guide, sensitizes the instructor to the tremendous opportunity for contributing to the physical and social adjustment of boys and girls. Causes for behavior that had not been noticed before became apparent, and a better understanding of children, their needs, and problems was gained.

Further logical analysis indicates that there may be a difference between general attitudes of the group, and attitudes of an individual in a particular situation. There may also be a difference in attitudes of the individual when he pictures himself in a situation and when he is actually in that situation. Additional study is needed to determine the degree to which control of the above factors would affect the correlations. The authors believe that with greater specificity of situation a much higher and more significant correlation would be secured in the comparison of observed behavior and how a person says he will behave.

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Some Effects of Training Upon Young and Middle-Aged Men

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Introduction

Acquiring and maintaining good physical condition when the so-called middle-age period of life is reached is of special concern to an increasingly large part of our population since we are gradually becoming a nation of older people. This phenomenon is due to the fact that, despite a brief war-time increase, the birth-rate in the United States has long been declining and improvements in diet and advances in medicine have increased the numbers who reach old age (2). Thus the proportion of middle-aged and old people in our population is steadily increasing.

Although recognizing that rising and falling curves of change in physical condition, as determined by tests of motor performance, can be expected to take place during the life span, the author has been concerned with the rapidity of the drop in performance at the beginning of the so-called middle-age period. The greatest obstacle confronting investigators in this area has been the difficulty of obtaining a large enough sample of men of various ages who were organically sound, and who could be subjected to a vigorous physical training program for several months under controlled conditions.

Such an opportunity was presented the author when an Army Specialized Training Unit was established on the University of Oregon campus in September, 1943. Army and Unit regulations prescribed the number of hours of participation in physical education per week for every man in the unit. An identical physical education program for all individuals was predetermined, the hours for study, recreation and sleep were prescribed and rigidly enforced, and similar meals were served to all men.

It was from the general assumption that the physical performances of individuals would improve while participating in a training program that the specific purpose of this study evolved. This was to determine the relative improvement that groups of men of various ages would show in specific motor performance tests after participating in a good physical education program.

The Procedure

A company of 185 men, who were being trained in "Area and Languages," was selected as an experimental group because it was composed of a larger number (26) of older men, aged 33 to 37 years, than any other company in the University of Oregon Army Specialized Training Unit. This company

also contained a smaller number of younger men (66), aged 18 to 22 years, than the other companies. The average age of the men in the experimental company was 26 years and 10 months as compared to an average of 20 years and six months for the entire Army Service Training Unit at the University of Oregon. The average age of members of a similar unit at Baylor University was 20 years and two months (3).

These men had been selected for special training chiefly because of linguistic ability and intelligence. They represented every section of the United States and were all members of the white race. Hereafter in the study this company of men will be spoken of as the Experimental Group and the Army Specialized Training Program as the A.S.T.P.

Members of the Experimental Group, like all of the other A.S.T.P. members, attended physical education classes three times each week. These classes were each two hours in length. The program includes calisthenics, aquatics, gymnastics, combatives, and indoor and outdoor sports. The men were given physical performance tests on September 13 which was at the beginning of the first term in the program, and were retested on December 3, which was at the end of the 12-week school term. These tests were Sit-up, Squat Jump, Squat Thrust, Push-up, Pull-up, Pick-a-back (100 yard) and 300 Yard Run.

Analysis of the Data

The first step in the analysis of data derived from these tests was that of determining the reliability for each test as a measure of its effectiveness as an instrument of measurement. All reliability coefficients were obtained by correlating the results of two successive administrations of each test to a group of subjects who ranged from 16 to 18 years in age.[1] The method used was that of determining Pearson-product-moment correlation coefficients (see Table 1). The reliability coefficients for the tests were found to vary from .627 to .900 and were therefore high enough to distinguish reliably between the means of two relatively small groups (4).

The next step involved a comparison of the means and gains registered by the Experimental Group with those made by other first-term A.S.T.P. students in the Oregon program as well as with those reported for typical Army Specialized Training Units in other colleges and universities. A study of Table 2 discloses that the scores registered by the Experimental Group in all the initial tests, except the 300 Yard Run, were poorer than those made by the other first term A.S.T.P. students at the University of Oregon. The second (December) test scores followed the same pattern since the Language and Area students again registered a lower mean in all seven tests than the other A.S.T.P. students at that school. When gains, both net and percentage, are compared, the performance of the Experimental Group does not differ markedly from the other groups in the same program. Both groups of A.S.T.P. students scored higher than the nationwide mean

[1] This group was 159 boys from junior and senior high-school classes who were more readily available for repeated measurement than the subjects used in this study.

in all of the December tests, except in Pick-a-back. In this test, the Experimental Group failed to equal the nationwide mean. The means for the Experimental Group (Table 2) fell in the following nationwide percentile ranks: Sit-up 85–90, Squat Jump 65–70, Squat Thrust 55–60, Push-up 55–60, Pull-up 40–45, Pick-a-back 30–35, and 300 Yard-Run 30.

Table 3 and Figure I represent the mean performances for groups within the Experimental Company when they are arbitrarily classified according

TABLE 1

Reliabilities of test variables

VARIABLE	NUMBER OF CASES	RELIABILITY COEFFICIENT	STANDARD ERROR
Sit-up	153	.709	.040
Squat jump	152	.650	.015
Squat thrust	152	.627	.032
Push-up	153	.781	.049
Pull-up	159	.900	.040
Pick-a-back (100 yd.)	155	.708	.017
300-yard run	156	.884	.047

TABLE 2

Means, standard deviations and gains for A.S.T.P. students

	LANGUAGE AND AREA STUDENTS (N = 186)						OTHER FIRST TERM A.S.T.P. STUDENTS AT OREGON (N = 376)						NATIONWIDE A.S.T.P. MEAN FOR SECOND TEST FOR FIRST-TERM STUDENTS*
	September		December		Gain		September		December		Gain		
	Mean	σ	Mean	σ	Net	%	Mean	σ	Mean	σ	Net	%	
Sit-up	40.1	16.2	61.9	38.4	21.8	54.3	46.7	14.3	76.4	32.9	29.7	63.6	40
Squat jump	38.1	10.6	47.0	11.9	8.9	23.4	41.1	12.5	50.4	13.8	9.3	22.6	41
Squat thrust	10.7	1.4	12.7	1.3	2.0	18.7	10.8	1.6	12.8	1.1	2.0	18.5	12
Push-up	19.9	7.1	28.1	6.3	8.2	41.2	21.6	6.7	29.7	6.6	8.1	37.5	24
Pull-up	5.8	2.8	6.6	3.2	.8	13.8	6.2	3.1	7.4	3.1	1.2	19.4	6.3
Pick-a-back	28.2	3.1	24.2	3.1	4.0	14.2	26.0	2.5	23.5	2.2	2.5	9.6	24
300-yd. run	43.7	6.6	43.9	3.9	.2	.5	44.4	3.0	43.8	3.0	.6	1.4	

* Headquarters, Army Service Forces, Army Service Forces Manual M 106, Physical Training Program for Army Specialized Training Program (A.S.T.P.) Trainees and A.S.T.R.P. Students, May, 1944.

to age. The 26 men, in the 33 to 37 years age group, averaged 34 years and 10 months in age while the 27 men in the 28 to 32 years age group averaged 30 years and two months in age. The 67 members in the 23 to 27 years age group averaged 25 years and two months in age while the 65 men in the 18 to 22 year age group averaged 21 years and one month in age.

Figure I illustrates the September and December performance scores for the youngest group (18 to 22 years) and the oldest group (33 to 37 years) in graphical form. It reveals that the older men were able to perform more Push-ups, Squat Jumps, Sit-ups, and Squat Thrusts and ran the Pick-a-back faster at the end of one term of physical education than the younger men

TABLE 3

Mean performance scores and gains

AGE GROUP	PUSH-UPS				SQUAT-JUMP				SIT-UP				PULL-UP				PICK-A-BACK				SQUAT THRUST				300-YD. RUN			
	Sep.	Dec.	Gain	%	Sep.	Dec.	Gain	%	Sep.	Dec.	Gain	%	Sep.	Dec.	Gain	%	Sep.	Dec.	Gain	%	Sep.	Dec.	Gain	%	Sep.	Dec.	Gain	%
18 to 22	23.6	28.5	4.9	20.8	39.1	47.9	8.8	22.5	44.5	73.4	28.9	64.9	6.2	7.2	1.0	16.1	27.0	23.4	3.6	13.3	10.9	13.0	2.1	19.3	44.3	42.7	1.6	3.6
23 to 27	20.0	28.7	8.7	43.5	35.4	45.3	9.9	28.0	39.8	59.4	19.6	49.2	6.3	7.4	1.1	17.5	27.2	24.3	2.9	10.7	10.4	12.3	1.9	18.3	47.0	44.5	2.5	5.3
28 to 32	19.7	28.0	8.3	42.1	35.9	44.0	8.1	22.5	35.8	51.1	15.3	42.7	5.6	6.3	0.7	12.5	28.8	25.8	3.0	10.4	10.7	12.7	2.0	18.7	47.7	46.0	1.7	3.5
33 to 37	18.6	25.6	7.0	37.6	32.3	44.6	12.3	38.1	33.7	54.1	20.4	60.5	4.5	5.8	1.3	28.9	28.9	25.6	3.3	11.4	10.3	12.3	2.0	19.4	48.7	46.5	2.2	4.5
Nationwide ASTP mean		24.0				41.0				40.0				6.3				24.0				12.0				44.5		

could at the beginning of the term. Only in the pull-up and the 300-yard run were they unable to equal or surpass the younger men's initial test performances.

Further study of Figure I reveals that the differences in the mean performances of the younger and older groups of men were less in December than in September in four of the tests. These tests were Push-ups, Squat-

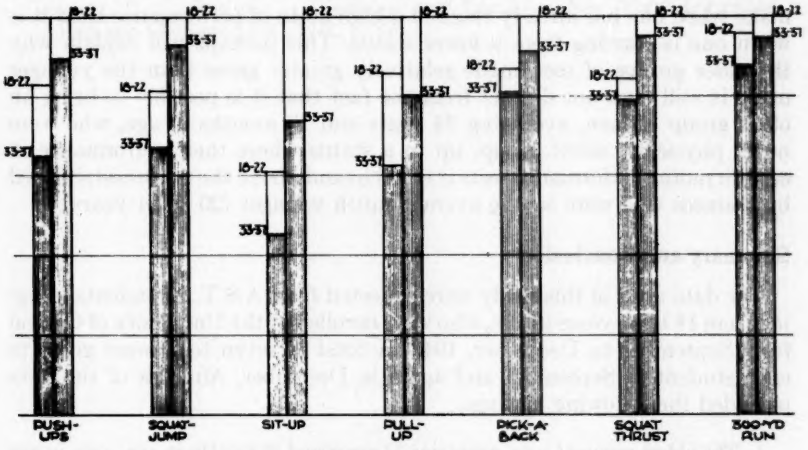

FIGURE I. A schematic diagram showing the relationship between the average scores of young men (18–22 years) and middle-aged men (33–37 years) before and after a term of physical education

For each test the first bar represents test performance at the beginning of the term and the second bar represents test performance at the end of the term.

TABLE 4

Composite "T" Scores and Gains by Age Groups

AGE GROUP	SEPT. SCORE	DEC. SCORE	DEC. GAIN OVER SEPT.	GAIN	NUMBER OF SUBJECTS
				%	
18 to 22	286.73	346.89	60.16	20.98	66
23 to 27	258.36	324.97	66.61	25.78	67
28 to 32	251.00	318.21	67.21	26.78	27
33 to 37	235.67	301.11	65.44	27.77	26

Jumps, Pull-ups, and 300-Yard Run. The younger men showed a greater degree of superiority over the older men in December than in September in the Sit-up and Pick-a-back tests.

Since the raw score test means cannot be added to form a composite value for each age group, it was necessary to convert the scores to T-scores. The composite T-score means and gains for the seven tests were therefore determined and are shown in Table 4. The formula used was $T = 50 - \frac{10}{\sigma}(X\text{-}M)$.

A study of these scores discloses that the oldest group (33 to 37 years) registered the highest relative gain (percentage) and that these gains became relatively smaller as the age groups became younger. Further examination of Table 4 reveals that although the youngest group (18 to 22 years) made a higher total score in both September and December than the three older groups of subjects, its composite gain was lower than any of the others. It is an accepted principle that improvement is more difficult to make when one has already reached a high state of performance than it is when one is starting from a lower status. This perhaps will explain why the older groups of men made relatively greater gains than the younger ones. It still does not detract from the fact that it is possible to bring an older group of men, averaging 34 years and 10 months in age, who were not a physically select group, up to a status where their performance in certain motor performance tests is equal to and above the norms established by trainees who were on the average much younger (20 to 21 years).

Summary and Conclusion

The data used in this study were collected from A.S.T.P. students, ranging from 18 to 37 years in age, who were enrolled at the University of Oregon from September to December, 1943. A total of seven tests were given to each student in September and again in December. Analysis of the data provided the following findings.

1. The oldest group of men, averaging 34 years and 10 months in age, were in one term of physical education brought to a status where their achievements in a group of motor performance tests were above the nationwide mean for all A.S.T.P. students. This latter group averaged less than 21 years in age in two schools where such programs were reported.
2. The oldest group of men registered higher mean performances in five of the seven tests in December than the youngest group did in September.
3. The oldest group of men registered a higher percentage of improvement in the tests than did the younger men in the program.
4. The youngest group of men, averaging 21 years and one month in age, scored the highest total of points in both the September and December tests, but registered the lowest total gains of all the age groups.
5. The oldest group of men scored above the nationwide mean for one term trainees in all but the 300-Yard Run.

The company used as an Experimental Group in this study was selected on the basis of convenience rather than by random sampling, so it may or may not be representative of the total population. The evidence indicates that a group of students approaching middle age who are organically sound and free from physical defects can achieve, through a good physical education program, a relatively high degree of ability to perform certain motor performance tests, and that in a 12-week period of time their degree of improvement will equal or excel that of younger men who have also been members of an intensive physical education program.

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A Comparative Study of Participation in Extracurricular Sports and Academic Grades

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AN EVALUATION of the intramural sports program, in terms of its relationship to academic grades, is of interest not only to teachers and administrators of physical education, but to all educators whose interests and responsibilities include an understanding of the total program of student activities both curricular and extracurricular.

The present intramural program, the result of an initial demand on the part of the students themselves, originated in the early 1860's (19) when university students associated in clubs and engaged in athletic competition in a more or less informal way. Since then, the program has developed through several stages to such proportions as to require the aid and supervision of the school administration, and is now an established part of the extracurricular program in many colleges, universities, and high schools.

In keeping with the current physical education theory, that of "developing each individual to his greatest possible physical capacity within the range of accepted educational objectives" (14), the intramural program offers athletic participation to practically all students, in contradistinction to varsity competition where only the few highly skilled may participate.

The objectives of the program, as described by Mitchell, are as follows: (a) Recreation; (b) Social Contacts; (c) Group Spirit; (d) Better Health; (e) Permanent Interest in Sports; (f) Development of Varsity Material; (g) Bodily Prowess; (h) Scholarship (20). The specific objectives of the physical education program which apply to the intramural program at Smith College where the present study was conducted are:

1. Good physical condition
2. Adjustment, as indicated by emotional control and balance
3. Worthy personal and social contact
4. Appreciations and knowledge, gained through physical education
   a. the relationship of good health to accomplishment in any field
   b. the relationship of beautiful balanced movement and posture to a sense of security and confidence
   c. the joy of sports
   d. the standards of the conduct of sports and recreational programs for future community responsibilities
5. Achievement of skill, in the various activities in which the student participates. (7)

The last objective is the one which is of the most "vital interest to the student, and it is through this medium that the program reaches out to the other less obvious and more subtle objectives" (7).

Although these positive values of athletic participation have come to be accepted generally, yet the question of the adverse effect of athletics on scholarship has been raised from time to time, provoked mainly by reports concerning those varsity athletes whose admittance to membership in the college community has been based on athletic prowess rather than on academic ability. Unfortunately, this situation made the entire sports program, including intramural competition, vulnerable to attack. As a result, a great deal of research has been carried on during the past several decades concerning the relationships existent between athletic participation and (a) academic grades, or (b) intelligence, or both. In reviewing the reports on this research, it is of interest to note that the studies on intramural competition indicate a trend toward a slight superiority of the athletes over the non-athletes in scholarship and IQ, while in the studies on varsity athletics the trend is in favor of the non-athletes. However, all differences were slight, and with two exceptions (2, 24) none proved to be statistically significant.

All of the studies reported have been conducted primarily on men students.

Purpose of This Study

The present study was conducted on a group of women students to compare the academic grades of participants in the intramural class team competition at Smith College with those of nonparticipants.

Procedure

In order to secure a comparison between the two groups of students as it exists from year to year in the normal college situation, it was decided to follow the four-year careers of the members of a specific class. The graduating class of 1948 was selected, since, at the time the research on this study was begun, the records of that class were the most recent which were complete and available for study.

The records in the College Registrar's Office were then consulted for the following data on each student in the class of 1948: (a) name, residence, and college house; (b) academic grade point average by year; (c) academic honors; (d) study abroad during junior and senior year; (e) number of years enrolled at Smith College; (f) offices held in student clubs and organizations; (g) participation in extracurricular activities (other than sports).

As a means of equalizing environmental factors in so far as possible only those students who had spent four consecutive years at the college were selected for the study. This narrowed the total number of subjects by excluding 260 students who spent less than four consecutive years at Smith College, and 30 students who transferred to the class of 1948 from another class, or to another class from the class of 1948. The remainder of the students, 384 in number, were the subjects used in this study.

The next step entailed reference to the records of the Physical Education Office, where permanent record cards are filed on all students, indicating, among other things, pertinent data regarding membership on class teams. This information was added to the data previously obtained from the Registrar's Office. To insure the accuracy of this data, the chronological registers of the 14 physical education activities in which there was interclass competition were consulted, and additional information annexed where necessary.

Finally, the College Medical Department files were examined to collect data on the activity ratings of each student. There were 22 students who had activity ratings of II or III for all or part of the four-year period. Those whose activity ratings were II were eligible for class team membership in only six sports: archery, badminton, crew (cox), fencing, golf, and riding; while those whose activity ratings were III were eligible for class team competition in only one sport, archery.

Description of Data

The method used by Smith College for computing grade letters into grade points is as follows: A=4 points; B=3 points; C=2 points; D=1 point. By multiplying the number of grade points by the number of semester hours the course carries, a grade point total is obtained for a single course. By adding the total number of grade points for all courses taken by a student during the school year, and dividing the obtained total by the number of semester hours involved, the grade point average is obtained, the range being from 0 to 4.0.

Class team competition was held in 14 sports during the years covered in this study (1944–1948): archery, badminton, basketball, crew, fencing, golf, hockey, lacrosse, riding, squash, soccer, swimming, tennis, and softball. A student is permitted to play on no more than one class team during any one season, and since there are three sports seasons in each year, the maximum number of class teams on which a student may play is three in one year, or 12 during the four-year period.

The extracurricular activities ascribed to students included membership in clubs, school organizations, selection to newspaper and magazine staffs, and election to administrative offices in the student-body organizations. In this study, these extracurricular activities are defined in distinction to extracurricular sports activities.

Table 1 shows a comparison of the grade point averages of the three, two, one, and zero season participants in class team competition for each of the four years. The greatest differences in grade point averages occurred in the freshman and sophomore years. In the freshman year, the mean grade point average of the three season group was .23 of a point below the means of the two and zero season groups, and .19 below the mean of the one season group. In the sophomore year, the mean of the two season group was .34 lower than that of the three season group, .27 lower than that of the non-participants, and .12 lower than that of the one season

group. Although the greatest actual difference between means occurred in the comparison of the three and two season participants in the sophomore year, this difference was not statistically significant. The only difference

TABLE 1

Number of seasons of participation, number of students, percentage of class membership, range of grade point averages, mean grade point average, and standard deviations for each of the four years

	NUMBER OF SEASONS OF PARTICIPATION	NUMBER OF STUDENTS	PERCENTAGE OF CLASS MEMBERSHIP	RANGE OF GRADE POINT AVERAGES	MEAN GRADE POINT AVERAGE
Freshman year (1944–45)	3	2	0	2.0–2.4	2.20 ± .20
	2	32	8	1.6–3.2	2.43 ± .45
	1	73	19	1.6–3.6	2.39 ± .41
	0	277	72	1.4–3.8	2.43 ± .49
Sophomore year (1945–46)	3	14	4	2.0–3.8	2.74 ± .53
	2	40	10	1.7–3.8	2.40 ± .43
	1	64	17	1.8–3.8	2.62 ± .48
	0	266	69	1.6–3.8	2.67 ± .46
Junior year (1946–47)	3	11	3	2.1–3.5	2.61 ± .38
	2	34	9	2.0–3.9	2.71 ± .36
	1	50	13	1.9–3.8	2.76 ± .47
	0	289	75	1.6–4.0	2.69 ± .46
Senior year (1947–48)	3	11	3	2.2–3.7	2.87 ± .41
	2	28	7	2.0–3.5	2.78 ± .36
	1	58	15	2.0–3.8	2.74 ± .37
	0	287	75	2.0–4.0	2.87 ± .42

TABLE 2

Number of students, percentage of class membership, range of grade point averages, mean grade point average, and standard deviations of class team participants and non-participants during each of the four years

	NUMBER OF STUDENTS	PERCENTAGE OF CLASS MEMBERSHIP	RANGE OF GRADE POINT AVERAGES	MEAN GRADE POINT AVERAGE
Freshman Year				
Participants	107	28	1.6–3.6	2.40 ± .42
Non-participants	277	72	1.4–3.8	2.43 ± .49
Sophomore Year				
Participants	118	31	1.7–3.8	2.56 ± .48
Non-participants	266	69	1.6–3.8	2.67 ± .46
Junior Year				
Participants	95	25	1.9–3.9	2.74 ± .43
Non-participants	289	75	1.6–4.0	2.69 ± .46
Senior Year				
Participants	97	25	2.0–3.8	2.77 ± .38
Non-participants	287	75	2.0–4.0	2.87 ± .42

that proved to be significant statistically during the entire four-year period was that of the two season group and the non-participant group in the sophomore year.

Another comparison was obtained by combining the academic averages of the three, two, and one season groups, and comparing it with the academic average of the non-participants. Here again, as indicated by Table

2, the differences between means were slight, and when tested statistically, none of the differences was significant.

In order to determine what effect class team membership might have on the subjects' cumulative four-year academic averages, the students were classified according to the number of seasons in which they had participated in interclass competition during their entire college careers. As shown in Table 3, those students who had participated on the greatest number of class teams, namely 11, (no student achieved the maximum of 12 seasons of participation) attained a mean grade point average, 2.64, which was identical with that of the students who had never played on any class team during their four years at college. The students who had played on 10 class teams during the four years attained the highest grade point average, 2.80. Among the groups who had played on from one to nine class

TABLE 3

Number of seasons of participation, number of students, percentage of class membership, range of grade point averages, mean grade point average, and standard deviations of 11 through zero seasons of participation on class teams

NUMBER OF SEASONS OF PARTICIPATION	NUMBER OF STUDENTS	PERCENTAGE F CLASS MEMBERSHIP	RANGE OF GRADE POINT AVERAGES	MEAN GRADE POINT AVERAGE
11	5	1.30	2.3–3.2	2.64 ± .11
10	3	.78	2.4–3.2	2.80 ± .10
9	7	1.82	2.4–3.2	2.64 ± .11
8	4	1.04	2.1–2.7	2.33 ± .17
7	13	3.38	2.3–3.2	2.65 ± .19
6	12	3.12	2.2–3.1	2.48 ± .27
5	10	2.60	2.1–3.6	2.69 ± .42
4	17	4.42	2.1–3.8	2.67 ± .42
3	29	7.55	2.1–3.5	2.66 ± .39
2	20	5.20	2.2–3.7	2.73 ± .37
1	39	10.15	2.1–3.9	2.64 ± .40
0	225	58.59	2.0–3.6	2.64 ± .40

teams during the four years, there was no trend in the differences among means which would suggest that participation in class team competition had affected academic grades. When these comparisons between means were statistically tested, the difference between the mean of the eight season group which was the lowest (2.33), and the means of the 10, 9, 7, 3, 2, 1, and 0 season groups proved to be statistically significant. One other difference between means, that of the 10 and 6 season groups of participants, was also found to be statistically significant, but since none of these significant differences concerned only a comparison between participants and non-participants, but were also among the participant groups themselves, it may be assumed that membership on class teams apparently has no definite effect on the students' cumulative academic averages.

It should be further pointed out that when the combined academic average of the entire participant group (11 through one season of class team membership) was compared with the academic average of the non-participants, it was found that the two groups had an identical academic average, 2.64.

A further comparison was obtained by selecting those students whose academic average during the four years ranked them among either the upper or lower 9%[1] of the class, and comparing the grade point averages, membership on class teams, and participation in other extracurricular activities.

Table 4 shows a comparison of the mean grade point averages of the participants and non-participants in the upper 9% of the class. Although the mean grade point average of the participants is slightly higher than that of the non-participants, this difference is not statistically significant. In another comparison of these two groups it was found that 75% of the participants proved to be Phi Beta Kappa students, as compared to 65% Phi Beta Kappa students among the non-participants. Mitchell (20) and Martin (19) made similar findings in their studies.

In the lower 9% of the class, the mean grade point averages of both the participants and non-participants was the same, namely, 2.09.

TABLE 4

Number of students, percentage of group membership, range of grade point averages, mean grade point average, and standard deviations of class team participants and non-participants in the upper 9% of the class

	NUMBER OF STUDENTS	PERCENTAGE OF GROUP MEMBERSHIP	RANGE OF GRADE POINT AVERAGES	MEAN GRADE POINT AVERAGE
Participants	12	34	3.17–3.90	3.47 ± .28
Non-participants	23	66	3.20–3.60	3.36 ± .21

Another interesting comparison within the upper and lower 9% groups lies in the amount of extracurricular activities (other than athletics) of each. Five of the 11 participants in the lower 9% engaged in from one to five other extracurricular activities, while only four of the 24 non-participants were active in one to two extracurricular activities.

In the upper 9%, 10 of the 12 participants engaged in from two to 13 other extracurricular activities, and of the 23 non-participants, 11 were active in from one to nine extracurricular activities.

These findings corroborate those of Rarick (22), Johnson (16), and Ray (23) concerning the fact that athletes tend to engage in a greater number of extracurricular activities (in addition to sports) than non-athletes. Ray referred to this greater activity on the part of athletes as good "citizenship" and found there was a direct relationship between it and leadership as well as high scholarship.

Conclusions

1. Participation in class team competition does not appreciably affect, either adversely or favorably, the academic grades of student participants.

[1] Ten percent was desired, but it was impossible to secure an impartial selection of students within the 10 percent bracket.

a. during any single year
b. during the cumulative four-year period

2. Students in the upper 9% of the class who participated in class team competition were slightly superior in academic average to the non-participants.

3. Students in the lower 9% of the class who participated in class team competition obtained an academic average equal to that of the non-participants.

4. The intramural participant, in both the upper and lower 9% of the class, is more active in additional extracurricular activities than the non-participant.

It would seem therefore, that it is possible for students to enjoy the benefits of intramural participation and at the same time maintain academic grades equal to those of non-participants.

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Static Ataxia in Relation to Physical Fitness[1]

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TO OBTAIN a means of determining physical fitness of athletes has been the desire of many coaches and trainers. Measures often used have involved the all-out performance of athletes such as running and other endurance events. Recently, tests of basic postural reflex adjustment have been used, a measure of body sway, which will be discussed in this study.

Probably the first accurate work with the ataxiagraph was undertaken by Miles (6) in 1922. He was mainly interested in the direction magnitude, difference of eyes-open and eyes-closed, position of feet, and effects of practice on body sway. He reported greater sway forward and backward than laterally, greater sway with eyes closed, considerable differences in sway due to positions of the feet, and slight effects of practice.

Fearing (4) studies the influence of factors of height and weight, athletic ability, and practice effect on body sway. Correlation of height and weight to amount of body sway was of a relatively low magnitude. Highest correlations for height and weight were $r = .22 \pm .06$ for both measures. Athletic ability did not yield results definite enough to warrant any conclusion. A later study by Fearing (4) agreed essentially with this one on practice effect. A small group of 16 subjects tested over a period of time varying from four to seven weeks showed about a 3% improvement in performance. Tests were given three days per week.

Work with the ataxiagraph next turned toward comparing body sway measure with the effects of various factors. In 1924, Miles (7) reported further a study of the effects of alcohol on sway. Eight subjects were compared with eight controls. All experimental subjects showed an average increase of sway amounting to 20% at some period after taking the alcohol. In a study of the effects of fatigue and of hours of driving upon truck drivers, Miles (7) determined the amount of sway after 10 or more hours of driving. With eyes closed, subjects who had driven longer periods showed considerable increase in sway during one minute intervals.

Collins and Howe (2) in a preliminary selection of tests of fitness submitted 42 young women of college age to 11 physiometric tests, among which was Miles' ataxiameter. Two groups were used, a graduate or "trained" group, and an undergraduate or "untrained" group. The "trained" group, who were students in the Department of Physical Education at Wellesley

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College, showed a superior score of 10% on the ataxiameter to the undergraduate group as a whole. The investigators considered this too small a difference to be significant.

Edwards (3) did extensive work on the measurement of static ataxia. Comparing age with sway, he found a clearly increasing steadiness as age increases from three to about 20 years. The following, taken from his study, includes only the ages in the present study. Scores in mm. of sway were:

C. A.	*Ss*	*M.*	*S. D.*
10–14	182	116.7	80.9
15–19	226	109.2	79.4

A study by R. T. Osborne under the supervision of Edwards (3), also compared age influence on body sway. Scores in mm. of sway were:

C. A.	*Ss.*	*M.*
12–13	49	90.00
14–15	48	72.75
16–17	22	66.66
18 plus	12	50.00

Both studies show a decrease in body sway as age increased. Edwards, in the same study, tested 16 football players for body sway, but found the results inconclusive due to the small number. In the results obtained, it appeared that the football players swayed twice as much as other students, and Edwards stated they had been "knocked about a good deal and a few had bodily injury." Those that swayed the most were retested after the football season and were found to sway about as much as the average student. The best player had the greatest sway of any of the players; he also returned to average after the season was over.

Travis (10) in a study of his stabilometer for measuring dynamic equilibrium in the standing position concluded that "preliminary studies have shown that individuals reporting fatigue, recent imbibing of alcohol, loss of sleep, or recent violent exercise tend markedly toward inadequacy in performance of this type, whereas those reporting previous training in dancing, skiing, gymnastics, and skating tend toward a performance far above average."

Travis (11) also investigated the relation between dynamic and static equilibrium. For dynamic equilibrium, he used a stabilometer which he constructed. The test on the stabilometer amounted essentially to maintaining postural balance on an unstable platform. Static equilibrium was measured using Miles' (6) ataxiagraph. Travis found that height, weight, and foot length have no effect on static equilibrium, furthermore that static and dynamic equilibrium are unrelated ($r = -.04$).

Fisher and others (5) investigated two tests of equilibrium: the railwalking test, a measure of dynamic equilibrium, and the ataxiagraph, a measure of body sway. The authors found a zero correlation between the two tests. In addition, practice effect on the railwalking test with 18 subjects and eight trials resulted in 89% improvement, while the ataxiagraph showed

with seven subjects and 10 trials an improvement of 8% with eyes open and 13% with eyes closed. The authors stated these differences showed that different sensorimotor performances were being measured. Scores on the ataxiagraph test of 120 subjects, two eyes-open and two eyes-closed, resulted in a correlation coefficient for eyes open (first trial vs. second trial) of 0.89; for eyes closed (first trial vs. second trial) the correlation coefficient was 0.85. Of the 120, 73 were retested within one week after the first session to study stability. The retest correlation coefficient of the eyes-open score was 0.79; of eyes-closed the score was 0.75. The conclusion of the authors was that both tests appear suitable as measures of sensorimotor performance, and, of the two, the ataxiagraph yields more reliable scores.

Patt (9), in evaluating certain tests of physical fitness, used the step up, tilt table, Army Air Forces, oxyhemoglobin reduction time, dynamometer, and the body sway tests. In addition, all subjects were interviewed by three medical officers who made independent estimates of their fitness. The tests were given to 105 volunteer hospital corpsmen and marines over a day and a half period preceding a fatigue test. This test consisted of vigorous calisthenics interspersed with brief hikes during the day, followed by a 23.5 mile all night run (requiring about 18 hours), which was the criterion selected for validation with the physical fitness tests. Motivation consisted of promise of a three day leave upon completion of the run. Some 49% failed to complete the 18 hour run, although most of these managed to continue nine or more hours. Body sway showed a significant biserial correlation with pass-fail performance, namely $r = .43$. Body sway, (among physical fitness measures of those who failed to complete the run and related to drop out time on the fatigue test), showed a significant correlation of $r = .45$. The author found that the "fail" group showed an increase in body sway, while a lesser change was noted in the pass group.

Man's ability to maintain an erect and stable posture will be briefly discussed in the following section. Obersteiner (8) has described three general systems of influence. These are: [1] Touch sensations of the soles of the feet, which are perceived by means of nerves from the joints, tendons, and muscles, [2] sensations from the labyrinth, and [3] optic sensations. The first, touch sensations, never reach the brain and the level of consciousness unless influenced by an unusual weight when they in turn become a muscular sense. Similarly, visceral sensations, due to their free hang, send equilibratory information to the brain though slight, and these also never reach the level of consciousness. The second, the labyrinth, represents a sense organ which gives to the individual information in regard to the position of the head in space and produces the sensation of turning. The third, optic sensations give information as to any change in the position of the body. The author emphasizes that the process of equilabration usually takes place unconsciously. He states that even with a disease of the spinal cord known as tabes dorsalis, where muscle sensations are reduced or arrested, the patient is able to stand "firmly" with feet together, offering least stability until the eyes are closed when dizziness and need for support arises.

Birren (1) studied the extent of the influence of the vestibular apparatus, a part of the labyrinth, on man's ability to maintain erect and stable posture. Observation was made on body sway of a 19-year-old male patient who had lost all eight nerve functions (vestibular) following an attack of acute meningococcus meningitis. In the first trial, marked body sway occurred, although he managed to maintain his balance with eyes open and closed. One month later the subject showed improvement in his postural control so that his record could no longer be considered pathological. The conclusions of Birren's study were that man may maintain stable posture despite loss of vestibular function and that "superficially it would seem that body-sway measurements were indicative of the adequacy of integration by the cerebellum of sensory cues arriving from many sources, among which those from the labyrinth are not the most important."

On the basis of the above studies, it appears that the use of body sway as a measure of basic postural integrity might be promising. The reviewed studies have shown practice effect to be largely of an insignificant nature. They have shown the factors of alcohol, fatigue, and recent exercise to be of significant influence on a subject's ability to maintain stable, erect posture in that body sway increased. Athletes were found somewhat superior in one study (2), while in another (3), football players swayed twice as much as other students. Since the sample was small, there was no statistical treatment of the data in both studies. The consideration of physiological effects on sway seem to indicate static equilibrium is maintained mainly at an unconsious level, and even severe vestibular defects may be compensated for; therefore, all bodily sources are contributing toward ability to maintain stable, erect posture. One study (3) showed age to be an influential factor within an age range similar to that employed in this paper.

The ability to succeed in athletics rests upon a number of bodily mechanisms working in a high degree of harmony. Among these bodily mechanisms is the factor of equilibrium. It would seem to be of great interest to determine, first, if this equilibrium is better in a group of skilled athletes than in a group of non-athletes. Secondly, since the accuracy of reflex adjustment is of value to the athlete, this study will seek to determine whether or not reflex adjustment or equilibrium improves as a result of the conditioning of athletes that occurs during a period of intense training.

Method

The apparatus (Figure I) used in this study for measuring body sway is an ataxiagraph similar to that used by Fisher and others (5) which offers the qualitative advantages of graphic recording. The anterior-posterior recordings of movements are made with the subjects standing erect with their heels together and their feet spread in a 30° "V" position. The subjects wear a type of helmet which can be tightened securely to prevent helmet movement on the head. Attached to the top of the helmet is a raised hook to which is fastened a string. The string runs over a pulley to the inkwriter of a spring-driven and governor-controlled kymograph which lies in a

horizontal position within a suitable box. Movements of the subject are translated into equivalent vertical lines on adding machine paper by the inkwriter.

Subjects are instructed to stand erect and to remain as still as possible, yet without undue strain. All trials are with eyes open for a two minute period as determined by a stop watch. Footgear consists of street shoes.

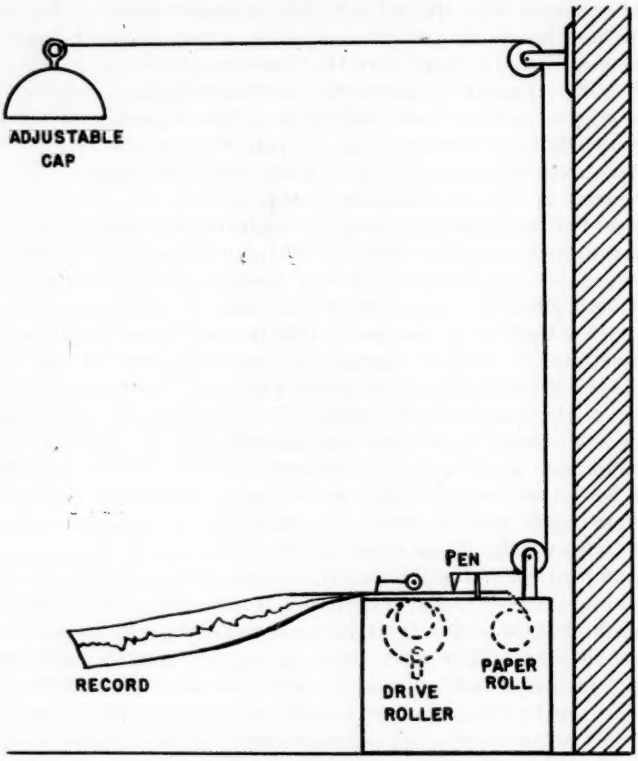

FIG. 1. The Ataxiagraph

Quiet during testing is achieved by having only the tester and one subject present as distractions might influence the score.

Fisher and others (5) used a method of scoring the graphic recordings where the length of the line traced by the subject was determined by a map measurer. Subtracted from this was the horizontal distance of the line traveled by the kymograph surface during the trial. The result was then converted into mm., of anterior-posterior movement by the equation:

$$\text{Score} = 1.135\ (\text{length of line}) - (\text{horizontal distance}) + 28.5.$$

This formula is the regression equation for predicting the actual excursion,

i.e. the sum of the directly measured vertical movements between successive maxima and minima. The correlation between the two methods was 0.95 on 56 one minute records.

In the present study, this method was used. To save time, conversion factors were worked out and tabled in accordance with the ratio of length of line to paper length. There was only a slight variation in kymograph speed.

In order to uncover some differences in various groups for ability to maintain stable, erect posture, the following procedure, which seemed best adapted to the situation and took as little of the student's time as possible, was used.

The student sample used was obtained from a large urban high school. Three groups totalling 99 boys, ranging in age from 12 to 19 years, were tested on the ataxiagraph.

The first was a group of athletes, 19 basketball players, and 15 football players, and all were either varsity or "B" team members. Testing of these players began as soon after school opened as possible. The second test was given when the subjects were considered at the peak of their physical condition which was, for both football and basketball players, within a week of the last game. The final test for this athletic group was given considerably after both seasons had ended, and the players were regarded as being no longer in good "condition" for the highly strenuous physical fitness required for both these sports. All tests, including the next two groups, were given before any strenuous exercise was allowed.

Grouping, relative to the subjects' states of condition, was necessary within these larger organization of groups as a result of the writer's inability to test them all within a comparable period of time. The sub-groups I to V have therefore been used to break down the data into homogeneous condition changes. A condition rating was assigned to each athlete, taking into consideration the length of time each had been out for a sport at the time of the test, injuries or illness which would prohibit participation, work or other activities of a strenuous nature, and the length of time each player was no longer in training for the sport. The condition rating was used to compare the first, second, and third tests; however, as will be noted, all the athletes were not tested three times. They were tested at least twice with one test in a trained state and the other in an untrained state.

In view of Edwards (3) results with injuries, no athlete who had been injured was tested unless he had apparently recovered and become restored to his normal status of condition.

The following rating scale of condition, it is felt, is a broad enough one to insure quite adequately the degree of athletic condition each player was in, especially the peak "in-condition" and the "out-of-condition" states. Regular physical education class participation only was placed at a 50% level of physical fitness, while varsity or "B" team participation for a period of six weeks or longer was considered at the 100% level of physical fitness.

Training period in weeks	*Percent of physical fitness*
Physical education class only	50
1	55
2	60
3	70
4	80
5	90
6	100

The same scale was used to determine "out of training condition," *e.g.* an athlete who has not been in training for football for four weeks would still have a physical fitness rating of 60%.

The first control group was composed of 24 boys who were classified as having poor athletic ability by the five coaches of the school. A questionnaire listing the boys as average, poor, or very poor was returned by the coaches, and they were in substantial agreement what all were poor or very

TABLE 1

Means of the combined athletic groups proceeding from an untrained to a trained condition (Influence of athletic training on ability to maintain a stable erect posture)

	NO.	PERCENT TRAINED	MEAN	PERCENT TRAINED	MEAN	"t" RATIO
Group I	3	55	1.462	100	1.389	1.91
II	8	70	1.233	100	1.289	2.63
III	3	65	1.446	100	1.398	0.91
IV	11	50	1.285	100	1.274	0.30
V	9	60	1.348	100	1.331	0.34
All skilled athletes (av)	34	59	1.319	100	1.314	0.32

poor in their physical education class activities. One test was administered to this group.

The second control group was made up of 41 boys who, because of various medical reasons, were not at the time taking part in physical education classes. All had been excused from participation in physical education for periods of one year or longer. One test also was given this group.

Experimental Results and Discussion

Means and "t" ratios are shown (Tables 1 and 2) of the trained athletic groups.

Group II of Table 1 shows a significant "t" ratio of 2.63, but it is of a small sample and probably represents a "fluke" because the percent condition change was very small. There were no significant changes in either table aside from this one group. The results for the athletic group indicate that the influence of training does not produce any improvement in ability to remain in a more stable, erect posture as shown by the ataxiagraph. This fact holds true regardless of whether the athletes were becoming more trained or were regressing to the "out of training" condition. Patt's (9) results showed a positive, but rather low, correlation between physical

fitness and ability to complete the criterion of a 23.5 mile 18 hour run. The present study agrees with Patt's in that body sway has a low positive correlation with physical fitness, but it is of an insignificant nature and would not, probably, serve as an indication of any degree of physical fitness.

A group of college students, 15 weight-lifters and 21 students in a body-building class, was also studied to determine if training over a six weeks' period improved scores in body sway. Results ("t" ratio = 0.51 and 0.69, respectively) also failed to show statistically significant effects of physical training.

TABLE 2

Means of the combined trained athletic groups proceeding from a trained to an untrained condition. (Influence of athletic training on ability to maintain a stable erect posture)

	NO.	PERCENT TRAINED	MEAN	PERCENT TRAINED	MEAN	"t" RATIO
Group I	3	100	1.389	50	1.363	0.94
II	8	100	1.289	70	1.291	0.10
III	2	100	1.413	90	1.708	3.85
IV	7	100	1.362	65	1.375	–
V	1	100	1.283	80	1.207	–
All skilled athletes (av)	21	100	1.340	68	1.367	0.86

TABLE 3

Means of poor athletic ability group, and medically restricted group. (Influence of poor athletic ability and medical restriction from athletics on ability to maintain stable erect posture)

	NO.	PERCENT CONDITION	MEAN
Poor athletic ability group	24	50	1.478
Medically restricted group	41	25	1.384

TABLE 4

"t" ratios between various groups

		SKILLED ATHLETIC	POOR ATHLETIC	MEDICALLY RESTRICTED GROUP
Skilled athletic group	N = 34		2.27*	2.17*
Poor athletic group	N = 24	2.27*		1.37
Medically restricted group	N = 41	2.17*	1.37	

* Significant at the 5% level.

Mean scores and "t" ratios are presented (Tables 3 and 4) for the control groups, but also includes the combined trained athletic group.

By inspection, it may be seen that a statistically significant difference ("t" ratio = 2.27) exists between the trained athletic groups and those students especially selected for their poor ability in physical education

activities. It would seem from this that the very poor in athletic ability show a distinctive lowering of quality in the basic processes assumed necessary for adequate athletic participation.

A statistically significant difference also exists between the medical non-participant group and the trained athletic groups, with the trained athletes showing better elements of basic postural integrity probably due to innate superiority in these basic postural adjustments.

This study agrees with the findings of Edwards (3) who found decreasing amounts of sway as age increased (Table 5). The mean scores, in general, show a decreasing sway with increasing age, although there is no statistically significant difference between any of the groups.

TABLE 5

Means and "t" ratios of age groupings and scores on the ataxiagraph

C.A.	N	MEAN	"t" RATIO
12	3	2.046	
13	3	1.634	
14	15	1.401	
15	22	1.349	
16	19	1.348	
17	19	1.323	
18	17	1.356	
12, 13 vs. 15, 16	47		1.88
14 vs. 17	34		1.43

Summary and Conclusion

In this study, 99 high school students, differentiated into three groups—athletes, non-athletes, and medically excused—were given a test in order to determine group differences in amount of body sway.

The following conclusions seem justified:

1. No statistically significant difference in basic postural integrity results from a process of athletic training.
2. Students selected by their coaches as being of poor athletic ability appear to have poorer postural integrity than the skilled athletic group.
3. Students who are unable to take physical education due to medical reasons appear to have poorer basic postural integrity than a highly skilled athletic group.
4. No statistically significant difference appears between the medical group and the poor athletic ability group in relation to postural integrity.
5. The amount of sway as related to age seems to be statistically insignificant.

The body sway test is concerned with measuring the integrity of the postural reflex adjustments involved in standing. It appears to be largely inherent or innate. The good athletes have less sway, whether they are in training or out of training, and the poor athletes or non-athletes have more sway.

The medically excused group, which also shows poorer accuracy of reflex adjustment than the highly skilled athletic group, does not appear to differ from the poor athletic ability group. When the means of the poor

athletic group and medically excused group are compared, the medical group appears to sway somewhat less than the athletic group; however, this difference is not statistically significant.

This study might suggest that the highly skilled athlete has elements of bodily coordination which may not be improved upon by training, but which are superior to the non-athlete or to the student who has been deprived of athletic participation due to medical reasons. Further, the non-athlete might be expected to have poorer accuracy of reflex adjustment than is typical of an unselected group of students, since the non-athletes tended to have poorer reflex adjustment than a medical group who were excluded from physical-education activity.

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A Study of the Effects of Smoking Upon Grip Strength and Recuperation from Local Muscular Fatigue

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Introduction

The use of tobacco is becoming more common and the social implications of its use more intensely felt. There are those who encourage smoking and others who expound upon its deleterious effects. Present knowledge as to the actual effects of smoking upon the human organism is limited. Much of the existing information is confusing and misleading. Therefore, there is a need for more isolated, scientific data which would throw light upon the effects of smoking.

Quite often the desire to smoke comes during the high-school or early college days. These are also the days which can be used advantageously for teaching physical activities. If the use of tobacco is detrimental to the human body, then smoking may well be expected to affect the individual's performance in physical activities. This phase of the problem is especially important to the athletics coach, the physical education teacher, or the recreation director engaged in conducting activities which demand superior physical performance.

Solutions to the questions surrounding the use of tobacco have been especially difficult because of the numerous variables which enter into any study of its effects. Because of these variables, it is difficult to conduct a controlled experiment using men as subjects. Another complicating factor is seen in the personal prejudices which are apt to prevent an objective study of the effects of smoking.

Purpose of the Study

The purpose of this study was to determine the effects of cigarette smoking upon grip strength and recuperation from local muscular fatigue. A knowledge of these effects will aid in clearing up the confusion which now surrounds the tobacco issue due to lack of adequate research.

In a study reported in 1949, Kay and Karpovich (4) concluded that the smoking of one cigarette after a period of work had no effect on recovery

from local muscular fatigue, caused by repeatedly squeezing a hand dynamometer. In the test they used, the work period after smoking was of four minutes duration, while the final rest period was five minutes long. The present investigators felt it worthwhile to change the previously used test by lengthening the work period after smoking, and shortening the final rest period. It was believed that the longer work period would improve the test in that it would provide more time for any depressing effects of smoking to become apparent.

Statement of the Problem

The problem of determining the effects of smoking upon grip strength and recuperation from local muscular fatigue presented the need for solving the following pertinent sub-problems with their various implications:

1. What is the rate of recuperation of grip strength as measured after a period of resting and smoking?
2. What is the rate of recuperation of grip strength as measured after a period of rest without smoking?
3. In comparing the rates of recuperation of grip strength revealed in solving the above sub-problems, what conclusions are drawn concerning the effects of smoking?

Scope of the Study

The study was limited to 14 habitual-smoking men students living in the men's residence halls at Purdue University. The men were all between eighteen and twenty-one years of age. All had smoked for at least one year. For a period of two hours immediately prior to taking the test, all subjects had refrained from smoking. They had refrained from eating for a period of one hour prior to the test. Grip strength was measured by having the subjects squeeze the dynamometer with the left hand. All subjects were right-handed.

In order that a comparison might be made with the study by Kay and Karpovich (4), it was felt desirable to use the same over-all time period for the test as was used in the earlier study. Therefore, the present study was limited to the effects of smoking on the rate of recuperation within a period of 12 minutes. During the first three minutes of this 12-minute period, the subjects, at their normal rates of smoking, smoked one-half to three-fourths of a cigarette.

Related Research

Earp (3) conducted a study of athletes who took part in some of the sports events at Antioch College in 1924 and 1925. His study revealed that in one of the track meets held at the college, non-smokers had received eight to 12 first places, light smokers had received two, while medium and heavy smokers had each received one. On the other hand, Dawson (2) found that 11 of the 28 men who finished in a Pittsburgh marathon used tobacco, and four of the first five were moderate users.

A study made by McCormick (5) indicated that the adrenal and consequent glycemic responses to narcotics and bacterial poisons, comparable to the releases following smoking, are partly responsible for the tolerance and resistance to foreign agents in the blood stream. Thus he concluded that the repeated glycemic responses with short time intervals between, as might occur in the habitual smoker, would actually decrease rather than increase the potential body supply of glycogen.

The data gathered by Pearl (6) indicated that length of life is associated with the use of tobacco, and the impairment increases in direct proportion to the amount of smoking.

Steinhaus and Grunderman (7) reviewed the work of several experimenters concerned with the problem of the effects of tobacco usage. Almost without exception, these studies revealed harmful effects. The results of an experiment conducted in 1949 by Autio, Eranko, and Jalavisto (1) showed that the heart rate of smokers tended to be higher than that of non-smokers.

Willgoose (8) studied the effects of smoking on the grip-strength scores of 15 men. He concluded that cigarette smoking after work lessened ability to recover from local muscular fatigue. Unfortunately, however, all subjects were given the test with smoking first, and the test without smoking second. Therefore, the better results obtained in the second test might have been due to familiarization with the test.

The study by Kay and Karpovich (4) was essentially the same as that of Willgoose, except that the "smoking" and "non-smoking" tests were given in random order so as to minimize the learning and psychological factors. The experimenters concluded that there was no significant difference in the results obtained with smoking and non-smoking, and that the difference reported in the earlier study by Willgoose was erroneous.

Procedure

The present investigation followed the same general procedure as that used by Kay and Karpovich.

The experimental apparatus included a dynamometer with a reset indicator of maximal tension, and a box containing two hidden smoking devices. The stem of a cigarette holder protruded through the box from each of the two hidden devices. One holder contained an actual cigarette used during the "smoking" part of the test. The other was mounted in plaster and constituted the placebo or make-believe smoking device. The plaster form had been molded around asbestos fiber which covered a nicrome wire. The wire was connected to the poles of an automobile battery. A small hole was made in the plaster form so that air could pass through it, over the coil, and through the cigarette holder. By dropping two drops of water into this hole before each "non-smoking" test, the air was not only warmed, but also moistened as it passed through the placebo.

The box containing the smoking devices was placed on a table, and a chair was placed so that the subject could sit in the chair and reach the

protruding stems of the cigarette holders. All subjects were blindfolded throughout the tests. Each subject was instructed to squeeze the dynamometer with maximum effort each time he was given the signal.

Although the procedure followed was, in general, the same as that used by Kay and Karpovich, the test items were altered somewhat. The initial grip strength was determined by averaging the first three grips in the initial work period. The second work period was lengthened from four to six minutes, and the final rest period was shortened from five to three minutes. These changes represent the essential difference between the present study and the previous experiment by Kay and Karpovich.

During the tests, each subject performed as follows:

1. Squeezed the hand dynamometer at 10-second intervals for a period of six minutes. (The dynamometer readings obtained for each squeeze during this and the following tests were recorded.)
2. Rested for three minutes. (During this period the subject smoked either the placebo or the real cigarette.)
3. Squeezed the hand dynamometer at 10-second intervals for a period of six minutes. (This test was designed to show the degree of recuperation after rest.)
4. Rested for three minutes.
5. Squeezed the hand dynamometer three times. (This test was expected to indicate the degree of final recovery.)

The above sequence was performed twice by each subject. In one performance, the subject smoked a real cigarette during the first three-minute rest period. In the other, he smoked the placebo.[1] The "smoking" and "non-smoking" tests were given in random order, with seven subjects taking the "smoking" test first, while the remaining seven took the "non-smoking" test first. Each subject took his second test two days after having completed the first test.

Method of Treating Data

For each test series for each subject, averages were computed for the following:

1. The first three grips in the initial work period. (This average was used as the initial grip.)
2. Each minute of the first six-minute work period.
3. Each minute of the second six-minute work period.
4. The last three grips. (This average was used as the final grip.)

The above averages were then tabulated in the following four categories:

1. "Smoking" tests.
2. "Non-smoking" tests.

[1] The make-believe smoking device used in this experiment was most successful. During the "non-smoking" tests, one of the investigators smoked a cigarette in the room close to the subject. Although many of the subjects expressed a belief that they were smoking a different brand of cigarette than that to which they were normally accustomed, none expressed doubt that he was actually smoking.

3. First tests. (The first test was either the "smoking" or "non-smoking" test, depending upon which test the subject took first in the two-test series.)
4. Second tests.

TABLE 1

*Group-mean grip scores**

(Figures are in kilograms)

TEST	INITIAL GRIP	MINUTES OF FIRST WORK PERIOD						MINUTES OF SECFND WORK PERIOD						FINAL GRIP
		1	2	3	4	5	6	1	2	3	4	5	6	
Smoking	41.7	41.1	38.6	37.2	36.9	36.1	35.7	40.6	37.7	35.4	34.7	34.6	33.6	41.0
Non-smoking	40.7	39.3	36.9	35.4	34.1	33.7	34.1	38.7	35.7	35.0	34.1	33.4	32.4	38.5
First†	39.8	38.8	37.0	34.9	34.1	34.2	34.3	38.5	36.3	34.2	33.3	33.6	32.6	38.9
Second†	42.6	41.6	38.5	37.7	36.9	35.6	35.6	40.8	37.4	36.2	35.5	34.4	33.3	40.6

* Means for each minute based on six trials per minute.

† Each subject was tested twice in random order. As a part of one test the subject smoked, but he did not smoke during the other test. Data for the "First Tests" and "Second Tests" were obtained during all first tests or all second tests, regardless of whether or not subject smoked.

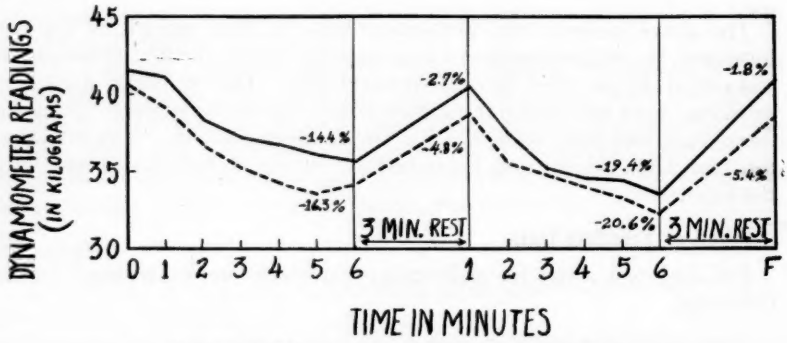

FIGURE I. Effect of smoking upon recuperation

Graph shows group-mean scores for fourteen subjects. —— Tests with smoking during first three-minute rest period. -------- Tests without smoking during the same period. O indicates initial grip; F indicates final grip. Percentage figures denote decrease with reference to initial grip strength. The graph indicates no significant difference in recuperation from fatigue resulting from smoking or not smoking during the first rest period.

Group-mean scores for the 14 subjects were computed in each of the four categories. These scores are shown in Table 1.

The same data were used in plotting two graphs. Figure I shows a comparison of the group-mean percentages of decrease in grip strength during the "smoking" and "non-smoking" tests. Figure II compares the data obtained during the first and second tests. The percentages of decrease shown

in these graphs were computed by comparing the respective points with the initial grip strength.

The difference between the initial grip strength and final grip strength was computed from the data collected during the "smoking" tests. This same difference was computed from data obtained during the "non-smoking" tests. The "t" ratio was then used in calculating the significance between these two differences.

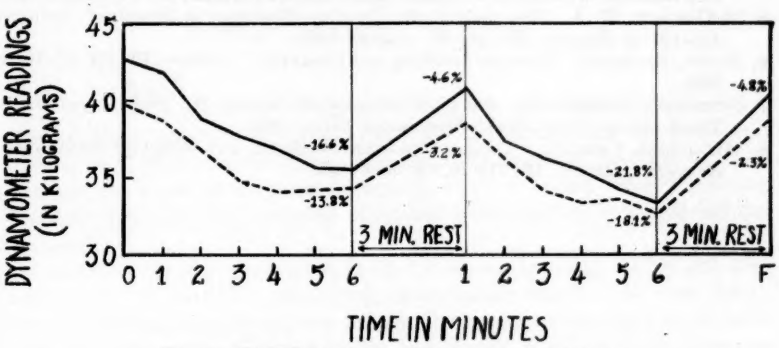

FIGURE II. Effect of practice upon performance

Graph shows group-mean scores for fourteen subjects. -------- First test. ——— Second test. O indicates initial grip; F indicates final grip. Percentage figures denote decrease with reference to initial grip strength. The effect of familiarization with the test is indicated by the slightly higher scores of the second test.

Findings and Conclusions

A careful analysis of the data obtained in this study revealed the following findings and conclusions:

1. The mean of the difference between the grip scores for the "smoking" and "non-smoking" tests shown in Figure I was found to be −4.9. The standard deviation of this difference was 10.8, and the standard error was 3. The value of "t" was found to be 1.63, which, with 13 degrees of freedom (N-1), is not significant within the 5% level of confidence. Therefore, it must be concluded that the smoking of one cigarette had no significant effect upon grip strength and recuperation from local fatigue of the flexors of the hand, within the time period used in this experiment.

2. The primary differences between the present study and the previous investigation by Kay and Karpovich were the extension in the length of time for the second work period of the test, and the shortening of the final rest period. It must be concluded that these changes in the test made no essential difference in the findings obtained.

3. The higher group-mean grip scores for the second test, as shown in Figure II, indicate a slight effect of familiarization throughout the test. This effect for the initial grip scores was statistically significant between the 2% and 5% level of confidence.

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A Comparative Study of Three Methods of Sit-Up Training

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WITH SIT-UPS as with most other physical education activities, there seem to be various methods of training that are employed by teachers of physical education. The speed sit-ups and the total number of sit-ups are those most often practiced, however many weight training enthusiasts practice total number of sit-ups while holding a weight behind their head.

In addition to the various methods of sit-up training, there are also several standard tests for measuring sit-up achievement. The one-, two-, three-, or five-minute sit-ups are among the speed sit-ups that have been in use (3). Among the higher number and longer duration type of sit-ups there are two methods of testing. One method is to establish the maximum number, i.e. 114 or 205 sit-ups,[1] and the other method is to perform the total number possible in an unlimited time.

This study will be concerned with determining which of the above three methods might be the best method of conditioning for the two-minute sit-up test, and which method might be better for the total number sit-up test.

A Review of the Literature

Wedemeyer (7) conducted a study to determine the relationship between sit-ups and such factors as sit-up strength, endurance, weight, etc. He concluded that (a) there was little relationship between sit-ups and sit-up strength, (b) after sit-up strength reached a certain level further improvement in the number of sit-ups was accompanied by no significant increases in strength, and (c) the endurance factor appeared to improve more than did strength.

Wedemeyer suggests that in further research another group training with progressively heavier weights be added to this study.

DeLorme (1, 2) after experimentation with exercises other than sit-ups states that (a) "low repetition, high resistance exercises produce power (strength)[2] and (b) high repetition, low resistance exercises produce endurance."

[1] The Army Air Corps and the Navy programs in physical fitness as well as many colleges and public schools use this method.

[2] Power is a combination of strength and velocity. Upon combining strength and velocity, power is developed. Therefore as strength is increased so is power increased (5, p. 56).

McCloy (6) suggests that, as far as endurance tests such as sit-ups are concerned they are strongly influenced by strength only at the lower levels, and that they are primarily measures of muscular endurance.

Procedure

SUBJECTS

Three groups of college freshmen and sophomore male students were used in this study. The first group, which will be referred to hereafter as Group I, was comprised of 45 students who practiced total number of sit-ups each class period. The second group, which will be referred to hereafter as Group II, was a group of 41 students, who practiced total number of sit-ups with a weight behind the head during each class period. The third group, which will be referred to hereafter as Group III, was a group of 42 students who practiced two-minute sit-ups each class period.

The total length of time of this study was 10 weeks with the first and last week taken for administering the tests.[3] Each group met two times per week.

ADMINISTRATION OF TESTS

The two-minute sit-up test was administered during the first class period of the first and last week of the 10-week period. The total number sit-up test was administered during the second class period of the first and last week of the 10-week period.

Both tests were administered according to standard instructions (8). The instructions for the total number test were as follows: (a) start from the supine position; (b) hold feet 12 inches apart firmly to the floor; (c) lace fingers together behind the head; (d) start on command, and alternate touching right elbow to left knee and left elbow to right knee; (e) touch both shoulder blades to floor before each sit-up; (f) maintain continuous motion at student's own speed; (g) stop only when the next sit-up cannot be completed after a five-second pulling attempt. This score will be recorded.

The instructions for the two-minute sit-up test were the same as the total number sit-up test with the following exceptions: . . . (f) sit up at a rapid speed; if rest is necessary stop and rest and start again (g); stop only if rest is necessary or at the end of two minutes. The score at the end of two minutes will be recorded.

The writer was aware of the fact that there would be students who because of lack of sleep, sickness, indisposition, etc., would not be able to achieve their best score on the day of testing. For this reason, the students were given the opportunity for a re-test upon request. Approximately 30% requested a re-test, and their better score was recorded.[4]

[3] All the students used in this study were members of classes taught by the writer. The testing was also conducted by the writer.

[4] The motivation of self and group improvement during this study was very effective, which resulted in the students doing their very best work. Consequently those that were dissatisfied with their scores tried a re-test.

Analysis of Results

The results of the three methods of sit-up training are discussed below.

TWO-MINUTE SIT-UPS

It can be seen from Table 1 that Group III exceeded Group II in mean gain which was statistically significant at less than the 1 percent level.[5]

TABLE 1

*Two-minute sit-up improvement**

	INITIAL	FINAL	GAIN	LEVEL OF SIGNIFICANCE	
				Group II	Group III
Group I†					
Mean	40.2	47.8	7.6	2% level	45% level
Median‡	39.5	48.5	9.0		
Group II					
Mean	46.6	50.2	3.6		Less than 1%
Median	47.3	51.5	4.2		
Group III					
Mean	45.7	54.4	8.7		
Median	45.5	54.5	9.0		

TABLE 2

Total number sit-up improvement

	INITIAL	FINAL	GAIN	LEVEL OF SIGNIFICANCE	
				Group II	Group III
Group I					
Mean	40.5	49.4	8.9	50% level	10% level
Median	40.4	46.0	5.6		
Group II					
Mean	42.7	50.8	8.1		35% level
Median	42.8	47.0	4.2		
Group III					
Mean	42.5	49.0	6.5		
Median	42.3	45.5	3.2		

* The mean and median in Tables 1 and 2 were computed from T scores.

† Group I practiced total number of sit-ups. Group II practiced total number of sit-ups with a weight held behind the head. Group III practiced two-minute sit-ups.

‡ The median gains are shown in Tables 1 and 2 in order that the reader may better visualize the group frequency distribution.

Group III also exceeded Group I in mean gain which was significant only at the 45% level. Group I exceeded Group II in mean gain, significant at the 2% level.

TOTAL NUMBER SIT-UPS

Group I exceeded Group II in mean gain, however at the very low level of significance of 50%. Group I exceeded Group III in mean gain which was

[5] The levels of significance were computed by the *t* statistic method (4, p. 51).

significant at the 10% level. Group II's mean gain was greater than the mean gain of Group III but at only the 35% level of significance. These findings are shown in Table 2.

Discussion

If McCloy's theory that the sit-up test is influenced by strength mainly at the lower levels and is primarily a measure of muscular endurance is correct, then there appear to be two types of muscular endurance: a speed endurance and a long term endurance. These two types of endurance seem evident when we inspect the results of Group II on the two-minute and the total number sit-up tests.

Theoretically, the two-minute sit-ups would require greater muscular strength, first because the greater speed of acceleration requires greater force, and second because fewer motor units would be required for each sit-up inasmuch as the rest periods for the motor units are much shorter than during a slow sit-up test. In addition to greater muscular strength, there must also be the best possible blood supply to the sit-up muscles, since working at top speed would create a greater demand than at a slow speed.

Assuming that the above discussion is correct, then a possible explanation for the small gain exhibited by Group II on the two-minute sit-ups might easily be that a larger number of repetitions type of sit-ups probably develops a greater increase in blood supply to the effected area than does the heavy resistive type of sit-up. Consequently, the students who practiced only heavy resistive sit-ups had not developed as much added circulation and were at a disadvantage when attempting the two-minute sit-ups.

A suggestion to weight trainers and others participating in training for strength and endurance would be to practice low repetition, heavy resistive exercises the first half of the training period for strength development, and follow this with high repetition, low resistive exercises for the remainder of the training period. At the conclusion of this type of training the individual should have developed both strength and a more adequate blood supply which results in greater endurance of both types.

It should be kept in mind that there were only 18 training periods, including the first week of testing. It is possible that different results would occur if the training term were longer and if there were more periods per week.

Summary of Findings

From the results of this study, it would appear that the practicing of either the two-minute sit-ups or the total number of sit-ups would be equal in preparation for the two-minute sit-up test.

In preparation for the total number of sit-up tests it is evident from this study that either practicing two-minute, total number, or total number with a weight behind the head would be nearly equal in results.

It is also felt that a combination heavy resistive and endurance type of

training program would be at least equally beneficial. However this method should be subjected to further study.

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The Evaluation of Attitude Toward Physical Education as an Activity Course[1]

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THE PURPOSE of this study was to attempt to develop an instrument which would enable one to make a reliable and a valid assessment of the direction and intensity of individual and group attitudes toward physical education as an activity course. There are several limitations and obstacles which must be considered when one attempts to make an objective evaluation of people's attitudes. There are also some precautions which must be taken, if the results are to be of maximum value. These limitations, obstacles, and precautions will not be discussed in this report. However, it is believed that they were handled properly in the study under consideration.

The validity of this instrument rests largely on logical foundations. However, some statistical evidence is given in support of the validity. Efforts were made to secure a valid instrument by the following means. (a) The attitude object was defined and an attempt was made to give the key-concept (physical education) approximately the same meaning for all subjects. (b) The customary method used in validating educational achievement tests, a wide sampling of accepted objectives, was employed. Statements were prepared which were intended to tap attitudes toward the commonly accepted objectives of physical education and toward the extent to which they are usually achieved. (c) A method which has been rather widely accepted and used by psychologists and sociologists in attitude studies was employed. (d) An attempt was made to construct the statements in such a manner that they would be clear and unambiguous. (e) Statements which ranked highest in power to differentiate between extreme groups as determined by total scores on the instrument were retained in a short form of the instrument. (f) Scores were compared with results obtained from the use of a graphic self-rating scale. (g) Personal data were secured from each individual regarding some of his present likes and dislikes and some of his past experiences with physical education and athletics which might presumably affect or reflect attitude toward physical education. Relationships existing between scores made on the evaluative instrument and scores made on these personal questions were studied. The power of the instrument to

[1] A condensation of part of a doctoral dissertation completed in the Division of Physical Education at the State University of Iowa.

differentiate between opposing groups as determined by answers to these questions was also investigated.

Related Studies

Most of the attitude studies in physical education during the past 20 years have been of the questionnaire type in which subjects checked likes or dislikes of activities, of features of the program, or of certain administrative practices. The writer has found reports of only three studies in which use was made of prepared attitude scales. All three of these scales were prepared and used in the Thurstone manner (7). In 1930–31 Stalnaker (5) made a study of attitudes toward intercollegiate athletics by the use of a list of scaled statements. College students were among the individuals studied. In 1941 Moore (4) reported the use of a Thurstone-type scale for testing the attitudes of college women toward physical activity as a means of recreation. Carr (1) reported in 1945 the use of an attitude scale developed by the Thurstone method for studying the relation between success in physical education and selected attitudes expressed by high-school freshman girls. No study was found which reported the use of an attitude scale or inventory for the evaluation of attitudes of college men toward physical education as an activity course.

Procedure

It was decided to attempt evaluation of attitudes by presenting statements to subjects in the manner described by Likert (3). Subjects were asked to respond to each statement by selecting one of five choices: strongly agree, agree, undecided, disagree, strongly disagree. A number of comparative studies involving the Likert and the Thurstone (7) techniques have shown that the two give practically the same results. Partly because of this, and since there is a great saving of time and labor in using the Likert method, it was selected for use in this study.

A list of statements representing expressions of attitude may be presented to individuals by either the Thurstone method or the Likert method without changing the wording of the statements. Thurstone asks an individual to check only the statements which he is willing to endorse or accept. Likert asks the individual to check *every* statement by selecting one of the choices accompanying each statement as indicated in the preceding paragraph. There are usually from three to five choices which vary in intensity from "strongly for" to "strongly against." A Thurstone statement has a definite scale value assigned to it according to a group of judges' ratings of the position which it is believed the statement should occupy on an intensity scale. A nine- or an 11-point scale is usually employed. A statement which is strongly for physical education would have a scale value near 9.0 or 11.0, while a statement strongly opposing physical education would have a scale value near 1.0. The median value of the judges' ratings is used as the scale value of a statement. The inter-quartile range of the many ratings is computed for each statement and is used in testing for ambiguity.

Thurstone also describes a test for similarity (7) which may be used for the elimination of certain statements from the final inventory. An individual's score on a Thurstone inventory is the mean of the scale values of the statements which the individual endorses. The Likert method does not require judges, nor does it assign a definite scale value to statements. The responses to each statement are arbitrarily weighted. An individual's score on a Likert inventory is the sum of the scores made on the various statements.

As the first step in the formulation and selection of statements to be used, it was considered advisable to review the outcomes which physical education seeks. Statements related to these outcomes would seem to be more relevant than any others in evaluating attitude toward physical education. There seems to be rather general agreement among authorities that the outcomes sought have to do with (a) physical well-being, (b) muscular strength and coordination, (c) total physical and muscular endurance, (d) acquisition of neuromuscular skills, (e) resources for recreation, for use of leisure-time now and in later life, (f) mental health, emotional control and poise, (g) social relationships, and (h) safety aspects, providing for better control of body and better use of safety measures.

After an analysis of the outcomes which are sought, there began the formulation and selection of statements which might represent verbal expressions of feeling concerning the value of these outcomes and the extent to which physical education was believed to bring about their attainment. Graduate and undergraduate physical education classes were asked to suggest (a) statements reflecting their own feelings, (b) statements which they had heard others make, and (c) statements which they thought other individuals, both favorable toward and opposed to physical education, might make. Many books and periodical articles were examined for suggestions. These procedures resulted in a list of 289 statements.

Next came the work of revising and eliminating statements. As a guide in this work the criteria suggested by Wang (8) were useful. These criteria are: (a) An attitude statement must be debatable—not a statement of fact. (b) All statements should belong to the same attitude variable. (c) A statement must not be susceptible to more than one interpretation. (d) Avoid "double-barreled" statements. (e) Statements should be short. (f) Each statement should be complete in denoting a definite attitude toward a specific issue. (g) Each statement should contain only one complete thought. (h) Avoid grouping two or more complete sentences as one attitude statement. (i) Statements should be clear-cut and direct. (j) Use with care and moderation such words as "only," "mere," "just" (in the sense of only), "merely," etc. (k) Avoid colorless expressions or statements lacking effect. (l) Whenever possible, write in the form of a simple instead of compound or complex sentence. (m) Use a complex rather than a compound sentence. (n) It is usually better to use active voice rather than passive. (o) In general use the term of the issue as the subject of the sentence. (p) Avoid high-sounding words, uncommon words or expressions, technical terms not ordinarily understood, etc.

No attempt was made to allocate any specific number of statements to the areas suggested by the outcomes mentioned above, although statements were formulated for each area. The editing resulted in a tentative list of 122 statements or items. As a result of analysis of responses from a preliminary try-out of these items on 75 college students, which included an item analysis of the 122 items, several items were dropped and a few new ones were added. The revised list, which now contained 120 items, was called the Physical Education Attitude Inventory.

In an evaluative instrument of this kind each statement is a scale in itself with each possible response being arbitrarily weighted. The range of scores possible on each statement was from one to five with the response considered most favorable to physical education receiving a score of five. The sum of the scores made on the individual items gave the total score of a student on the Inventory. The meaning of scores made on the Inventory as a whole is limited by the meaning that may be attached to scores made on individual items and by the extent to which one may justify the summing of item scores.

It is believed that the Inventory will place individuals in rank order regarding intensity of attitude toward physical education and will indicate the direction and extent of shifts of individual and group attitudes. While the Inventory as a whole "measures" whatever the individual items measure it is assumed that a total score on the Inventory is an index of attitude toward physical education as an activity course since the key-concept to be used as a basis for selecting responses to items was so defined and the items were directed toward this common concept.

Approximately half of the items were worded negatively. The purpose of this was to counteract any suggestive effect which an all-positive list might have on the subjects responding to the items.

The Inventory was given to the classes in required physical education for men at the State University of Iowa at the beginning of the first semester of the 1949–50 school year. Each student was asked (a) to fill out a one-page questionnaire concerning some of his past experiences with physical education, including some of his likes and dislikes, (b) to mark one of the five possible responses for each of the 120 items of the Inventory, and (c) to rate himself on a nine-point graphic rating scale concerning his general attitude toward physical education as defined. The self-rating scale consisted of a line five inches long divided into five equal segments by short vertical lines.

Underneath the segments the following descriptive words or phrases were placed, going from left to right: "strongly for," "for, but not strongly," "neutral," "against, but not strongly," "strongly against." The subject was asked to place an "x" above the segment which best indicated his feeling toward physical education. If the subject was not sure just which of two adjacent segments he desired to mark, then he was asked to place his mark *exactly on* the vertical line between the two segments. Thus there were nine possible choices. It was believed that the most practicable, as well as the most useful, criterion external to the Inventory itself that could serve as a

check on the validity of the Inventory would be an individual's rating of his own general attitude toward physical education. Subjects were asked to omit names from papers.

The purpose of the questionnaire was to secure information which might give support to the validity of the Inventory. This would be an indirect, though useful, check on validity. Actually one would be considering the consistency with which certain measures of attitude were "hanging together," none of which had been validated statistically against an external criterion. However, justifying validity from a logical point of view, the indication of a significant positive relationship between responses to the selected questionnaire items and Inventory scores would seem to strengthen the usefulness of the Inventory as an instrument for evaluating attitude as defined. In selecting questions for use in the questionnaire, several types of experiences and several kinds of likes and dislikes were considered. Those experiences and feelings which the writer believed should be most logically related to attitude toward physical education were used. Most of the like-dislike items were set up in multiple-choice form to be answered on a five-

TABLE 1

Ranges, means, and standard deviations for 120-item scores

N	RANGE	MEAN	SD
472	214–600	459.78	63.30
272	214–600	461.00	64.61
200	249–577	458.12	61.44

point intensity scale of preference or liking and were scored on a 5-4-3-2-1 basis.

Analysis of Data

Responses were secured from 494 men students. This was an unselected sampling of the total number of less than 600 students in the required program. Excuses from the required program were issued only to war veterans who desired to be excused and to students who were classified by the student health center as being unfit for any kind of activity. Those not excused, but who were unable to take part in the regular class work, were enrolled in the adaptive program. These students were included in the 494 responses. Twenty-two of the papers had omissions in the Inventory section or indicated obvious non-cooperation. This left 472 papers for use in the study. Of these papers 332 were from beginning freshmen.

The reliability of the Inventory as determined by the split-halves technique was 0.96 for 472 cases which became 0.98 when raised by the Spearman-Brown formula. The product moment correlation between Inventory scores and graphic self ratings for the 464 individuals who rated themselves was plus 0.80.

Two hundred papers were removed at random from the 472 and were set

aside for use in checking a short form that was to be derived from the data of the remaining 272 papers.

Product moment correlation coefficients were computed to express the relationships between Inventory scores and scores made on the multiple-choice items of the questionnaire. The coefficients indicate that a significant relationship, although low in most instances, exists in every case, except for the number of years taken in high school. The questions on the questionnaire having a correlation of 0.40 or better with total Inventory scores were as follows (possible responses are omitted). (a) How important do you consider physical activity (sports or athletics) at the present time as a part of your personal recreation program? $r = 0.64$. (b) If you *did not take* physical education in high school, do you think you would have liked it? $r = 0.56$. (c) To what extent do you *like to participate* in sports activities? $r = 0.48$. (d) If you took physical education as an activity subject during school hours in high school, did you like it? $r = 0.46$.

Some questionnaire items seem to be very similar to certain Inventory items. However, the questionnaire items were selected because they seemed to be logically related to *general* attitude while the Inventory items were intended to tap more *specific* attitudes. The 40 Inventory items were selected as a result of an independent statistical analysis of a list of 120 items which were answered at the same time as the questionnaire. The questionnaire-item responses, as representations of a general attitude, were correlated against total Inventory-item scores, also used as indicators of a general attitude.

In another type of analysis an investigation was made of the extent to which scores tended to differentiate between groups which had undergone different experiences or which held to different feelings or practices as indicated by responses to the questionnaire items. For each item the subjects were divided into two groups on the basis of the selected responses. Mean scores for groups were computed and the significance of the difference between means of paired groups was tested by comparing the difference with its standard error. These data are given in Table 2. In addition to the four questions listed above, and the graphic self-rating results, this table also gives data for the following questions. (e) While in high school did you actually take part in any athletic game or contest for your school against another school? (f) If your high school had an intramural sports program, did you take part in any of the sports? (g) If you took physical education in high school, did you like your instructor (or instructors)? (h) How much of your leisure time do you devote to swimming, playing tennis, golf, hand ball, or other similar sports activities?

Inventory scores failed to differentiate between groups at the 5% level of confidence on only one questionnaire item. This item called for the number of years of participation in physical education in high school. The groups tested and the corresponding significance ratios on this item were as follows: none vs. one year, 1.83; none vs. two or more years, 1.70; one year vs. two or more, 0.65.

Using the 272 cases the writer secured estimates of the product moment correlation between scores on each of the 120 items and total scores on all items by the use of Flanagan's table (6, p. 348). A score of 4 or 5 on an item was considered as "passing," while a score of 1, 2, or 3 was considered as "non-passing." A correlation coefficient thus obtained may be considered as representing the power of an item to discriminate between individuals who possess a favorable attitude toward physical education and those who

TABLE 2

Comparisons of group means based on scores on 120 items: groups defined on basis of responses to questionnaire items

	N	M	SD	SR*
Self-Ratings				
For	399	476.16	48.06	
Not for	65	365.72	57.06	14.76
Question a (see text)				
Important	196	482.25	50.35	
Not important	75	405.44	65.15	9.21
Question b				
Like	42	474.50	48.29	
Dislike	41	423.07	72.53	11.33
Question c				
Like	197	477.99	55.46	
Dislike	71	415.86	66.28	7.06
Question d				
Like	163	476.69	56.89	
Dislike	60	427.70	65.40	5.14
Question e				
Yes	302	467.77	57.65	
No	122	435.32	70.58	4.51
Question f				
Yes	197	464.45	64.60	
No	54	441.00	66.04	2.32
Question g				
Like	170	471.39	62.63	
Dislike	55	439.09	57.24	7.71
Question h				
Quite a bit	68	477.13	57.38	
Little or none	201	456.25	66.11	2.49

* Significance ratio: the difference between means divided by the standard error of the difference. Reference to a normal probability table shows that a ratio of 1.96 is significant at the 5% level of confidence and that a ratio of 2.58 is significant at the 1% level.

possess an unfavorable attitude. The larger the coefficient the greater is the discriminative power of an item. The assumption is made, of course, that total scores are indicators of favorable and unfavorable attitudes toward physical education. The purpose of this analysis was to arrange the 120 items in rank order on the basis of their respective indices of discrimination. The range of these indices was from 0.16 to 0.82 with a median of 0.58.

As a first step in the derivation of a short form of the Inventory those items were retained which had indices of discrimination above the median of 0.58. There were 58 such items. Inspection of these 58 items showed that

there was retained at least one item from each of the eight areas of outcomes or objectives. A second item analysis was now made on the 120 items using the total scores made on the 58 selected items as the criterion scores. There was no marked rise or drop in the discrimination power of any item.

These 58 items were now examined from the standpoint of duplication in tapping the various aspects of attitude toward physical education. Fifty-five pairs of apparently similar items were selected for examination. Using 100 papers selected at random from the 272 papers tetrachoric correlation coefficients were computed for each pair from the Chesire-Saffir-Thurstone computing diagrams (2). Although the assumptions underlying the use of tetrachoric formulas may not be strictly applicable in these situations, it was believed that this method was the most practicable method available for securing an estimate of the degree of similarity for a large number of pairs of items. A score of 4 or 5 was considered as "passing" for each item, and a score of 1, 2, or 3 was considered as "non-passing." The size of the correlation coefficient which would call for the elimination of one of the items of a pair from the selected list of 58 items was arbitrarily set at 0.70. Twenty-one of the pairs had coefficients of 0.70 or better. This resulted in the elimination of 17 items. In deciding which items of a pair to drop consideration was given to such factors as (a) whether the item was stated negatively or positively. Other things being approximately equal, negative items were preferred for retention because more of the 58 were positive; (b) the size of the index of discrimination of each item; (c) the total number of students who had received a score of 4 or 5 on the item in the two extreme groups used in the original item analysis—an item which was accepted by nearly everyone or rejected by nearly everyone was usually eliminated.

Of the 41 items remaining, 24 were positive and 17 were negative. One of these positive items was dropped and two others were replaced by negative items which were not in the selected list of 58. This resulting list of 40 items was called the Short Form of the Inventory. The Short Form had a split-halves reliability of 0.94 for 272 cases. This becomes 0.97 when raised by Spearman-Brown formula. The product moment correlation between Short Form scores and the graphic self-ratings was 0.80 for 268 cases. Inspection of these 40 items showed that all outcome areas established at the beginning of the study were tapped.

It is a well-known fact in test construction that where a test is validated against an outside criterion there is usually a "shrinkage" in the validity coefficient from the group of subjects used in the construction of the test to a new group. It is important to know the amount of this shrinkage. Although in this study validity does not rest primarily on the degree of correlation with an external criterion, nevertheless certain coefficents derived from data of the original group of 272 cases used in the construction of the Short Form of the Inventory were compared with coefficients derived from the data of the 200 cases not used in the construction

The split-halves reliability of the Short Form for the 200 cases was 0.93,

which became 0.96 when raised. The correlations between Short Form scores and graphic self-ratings for the 272 cases and the 200 cases were 0.80 and 0.81, respectively. The correlations between Short Form scores and scores on the question "How important do you consider physical activity (sports or athletics) at the present time as a part of your personal recreation program?" for the 272 cases and the 200 cases were 0.64 and 0.62, respectively. An item analysis of the Short Form items, using data from the 200 cases, showed a slight drop in discrimination indices from the 272 cases for all but two of the items. The mean drop was 0.04.

Summary

An instrument for the evaluation of attitudes of college students toward physical education as an activity course has been constructed. The instrument has taken the form of an inventory of 120 statements. The individual indicates his degree of agreement or disagreement with each statement. These statements are believed to be related to the outcomes which authorities in the field of physical education generally agree should result from a well-balanced and well-conducted program of physical education.

TABLE 3

Ranges, means, and standard deviations for short form scores

N	RANGE	MEAN	SD
472	59–200	153.53	23.77
272	59–200	153.76	24.65
200	73–195	152.81	22.40

The reliability of the Inventory has been shown to be statistically satisfactory. It is believed that the validity of the Inventory has been established by: (a) the use of certain criteria in the wording of statements; (b) a comprehensive sampling or tapping of important outcomes; (c) the demonstration of a substantial relationship between scores made on the Inventory and certain other data regarding attitudes toward physical education; (d) the demonstration of significant differences between attitudes, as evaluated by the use of Inventory scores, of certain groups of individuals who might presumably differ.

By eliminating statements whose indices of discrimination were below a certain arbitrarily selected point and by eliminating one of pairs of statements which seemed to tap approximately the same aspect of attitude the Inventory was reduced to a list of 40 items which was known as the Short Form of the Inventory. All the major outcomes sought by physical education were still represented and the Short Form was shown to be statistically reliable.

When the Short Form was applied to a group other than the one used in its construction, correlations of scores with graphic self-ratings and with responses to a question regarding attitude toward personal recreational

activity remained approximately the same. Also, individual statements still showed approximately the same discrimination power.

Conclusions and Recommendations

As a result of analysis of the data collected by means of the procedures described in this study the following conclusions are drawn.

1. Through responses to a relatively small number of statements related to the outcomes sought by means of physical education activities it is possible to secure a reliable and valid evaluation of attitude toward physical education.
2. Considered collectively, the statements seem to be of a rather highly homogeneous nature.
3. As a result of its application to a group other than the group used in its construction it is believed that the Short Form will give a valid evaluation of attitude, as defined, when used generally with college men.
4. Because of the nature of the individual statements, it is believed that the Inventory would be equally suited for use with women's classes. Also, it is believed that the level of difficulty of the vocabulary involved would not make the Inventory unsuited for use with high-school classes.
5. It is believed that either the total Inventory or the 40-item Short Form will serve a useful purpose when used as an evaluative instrument for securing an objective assessment of changes in attitude toward physical education. With the establishment of norms, meaningful interpretations might be made of scores relative to defining the present status of an individual or of a group.

Because of the importance of attitudes, and their changes, there should be a much wider use of objective evaluation methods. Instruments should be constructed for evaluating attitude toward certain specific types of activities (gymnastics, swimming, etc.), toward competitive and non-competitive activities, and toward individual and team activities.

Controlled experiments should be made concerning the effect upon attitudes of various types of programs, of various administrative measures and methods, and of various methods of instruction. Some experiments might be planned for the purpose of evaluating the effects of a lecture, a movie, or a reading assignment.

APPENDIX

Physical Education Attitude Inventory

Directions—Please Read Carefully: Below you will find some statements about physical education. We would like to know how you feel about each statement. You are asked to consider physical education *only* from the standpoint of its place as an activity course taught during a regular class period. No reference is intended in any statement to interscholastic or intramural athletics. People differ widely in the way they feel about each statement. There are no right or wrong answers.

You have been provided with a separate answer sheet for recording your reaction to each statement. (a) Read each statement carefully, (b) go to the answer sheet, and (c) opposite the number of the statement place an "x" in the square *which is under* the word (or words) which best expresses you

feeling about the statement. After reading a statement you will know at once, in most cases, whether you *agree* or *disagree* with the statement. If you *agree*, then decide whether to place an "x" under "agree" or "strongly agree." If you *disagree*, then decide whether to place the "x" under "disagree" or "strongly disagree." In case you are undecided (or neutral) concerning your feeling about the statement, then place an "x" under "undecided." Try to avoid placing an "x" under "undecided" in very many instances.

Wherever possible, let your own personal experience determine your answer. Work rapidly, do not spend much time on any statement. This is not a test, but is simply a survey to determine how people feel about physical education. Your answers will in no way affect your grade in any course. In fact, we are not interested in connecting any person with any paper—so please answer each statement as you actually feel about it. *Be sure to answer every statement.*

Statements

1. If for any reason a few subjects have to be dropped from the school program, physical education should be one of the subjects dropped.
2. Associations in physical education activities give people a better understanding of each other.
3. Physical education activities provide no opportunities for learning to control the emotions.
4. Engaging in vigorous physical activity gets one interested in practicing good health habits.
5. Physical education is one of the more important subjects in helping to establish and maintain desirable social standards.
6. The time spent in getting ready for and engaging in a physical-education class could be more profitably spent in other ways.
7. Vigorous physical activity works off harmful emotional tensions.
8. A person's body usually has all the strength it needs without participation in physical education activities.
9. I would take physical education only if it were required.
10. Participation in physical education activities tends to make one a more socially desirable person.
11. Participation in physical education makes no contribution to the development of poise.
12. Physical education in schools does not receive the emphasis that it should.
13. Because physical skills loom large in importance in youth it is essential that a person be helped to acquire and improve such skills.
14. Physical education classes are poor in opportunities for worthwhile social experiences.
15. Calisthenics taken regularly are good for one's general health.
16. A person would be better off emotionally if he did not participate in physical education.
17. Skill in active games or sports is not necessary for leading the fullest kind of life.
18. It is possible to make physical education a valuable subject by proper selection of activities.
19. Physical education does more harm physically than it does good.
20. Developing a physical skill brings mental relaxation and relief.
21. Associating with others in some physical education activity is fun.
22. Physical education classes provide nothing which will be of value outside of the class.

23. Physical education classes provide situations for the formation of attitudes which will make one a better citizen.
24. There should not be over two one-hour periods per week devoted to physical education in schools.
25. Physical education situations are among the poorest for making friends.
26. Belonging to a group, for which opportunity is provided in team activities, is a desirable experience for a person.
27. There is not enough value coming from physical education to justify the time consumed.
28. Physical education is an important subject in helping a person gain and maintain all-round good health.
29. Physical education skills make worthwhile contributions to the enrichment of living.

TABLE 4

T-scores corresponding to given raw scores

R	T	R	T	R	T	R	T	R	T	R	T
200	78	175	60	150	47	125	38	100	31	75	26
199	77	174	59	149	47	124	38	99	31	74	25
198	76	173	59	148	46	123	37	98	30	73	25
197	75	172	58	147	46	122	37	97	30	72	25
196	74	171	58	146	46	121	37	96	30	71	25
195	73	170	57	145	45	120	36	95	30	70	25
194	72	169	56	144	45	119	36	94	30	69	25
193	72	168	56	143	44	118	36	93	29	68	24
192	71	167	56	142	44	117	36	92	29	67	24
191	70	166	55	141	43	116	35	91	29	66	24
190	69	165	54	140	43	115	35	90	29	65	24
189	68	164	54	139	43	114	35	89	28	64	24
188	68	163	53	138	42	113	34	88	28	63	24
187	67	162	53	137	42	112	34	87	28	62	23
186	66	161	52	136	42	111	34	86	28	61	23
185	66	160	52	135	41	110	34	85	28	60	23
184	65	159	51	134	41	109	33	84	27	59	23
183	64	158	51	133	41	108	33	83	27	58	23
182	64	157	50	132	40	107	33	82	27	57	23
181	63	156	50	131	40	106	33	81	27	56	23
180	63	155	50	130	40	105	32	80	27	55	22
179	62	154	49	129	39	104	32	79	26	54	22
178	62	153	49	128	39	103	32	78	26	53	22
177	61	152	48	127	39	102	32	77	26	52	22
176	60	151	48	126	38	101	31	76	26	51	22

30. No definite beneficial results come from participation in physical education activities.
31. People get all the physical exercise they need in just taking care of their daily work.
32. Engaging in group physical education activities is desirable for proper personality development.
33. All who are physically able will profit from an hour of physical education each day.
34. Physical education activities tend to upset a person emotionally.
35. Physical education makes a valuable contribution toward building up an adequate reserve of strength and endurance for everyday living.
36. For its contributions to mental and emotional well-being physical education should be included in the program of every school.

37. Physical education tears down sociability by encouraging people to attempt to surpass each other in many of the activities.
38. I would advise anyone who is physically able to take physical education.
39. Participation in physical education activities makes for a more wholesome outlook on life.
40. As far as improving physical health is concerned a physical education class is a waste of time.

Scoring

As previously explained there are five possible responses to each Inventory item: strongly agree, agree, undecided, disagree, and strongly disagree. The response considered most favorable to physical education receives a score of 5. Thus the above responses would be scored 5-4-3-2-1 or 1-2-3-4-5, depending on whether the item was worded positively or negatively. A subject's score on the Inventory is the sum of the scores made on the individual items. According to this method of scoring, a high score would indicate a favorable attitude toward physical education.

Table 4 gives normalized T-scores which were derived from the Short Form raw scores of the population of 472 college men, 332 of whom were beginning freshmen. After being calculated the T-scores were plotted against the corresponding raw scores. A curve was then fitted to the plotted points and smoothed. The T-scores given in the table were read from this smoothed curve.

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Guide to Authors

IN line with the overall goal of making Association publications yield the greatest value to the individual and profession, the following is a yardstick for the preparation of research manuscripts. The information as spelled out below recognizes general techniques being employed by research publications of similar nature. Copy prepared on this basis looks forward to the establishment of a standard style for all Association research studies.

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Manuscripts should be sent to the Editor who will see that each one is read by at least three members of the Board of Associate Editors. The Editor will advise the author as to the suitability of the paper or the desirability for revision. Papers are not judged by arbitrary standards of length but on their content of new research results in the field of physical education, health education, and recreation, presented with the greatest brevity compatible with scientific accuracy and clarity.

Since three members of the Board of Associate Editors review an article it is requested that at least two copies of the manuscript (the original and a clear carbon) be submitted in order to facilitate reviewing. One copy of the article should be retained by the author for checking against galley proofs.

Typewritten manuscript should be double spaced on white paper of ordinary weight and standard size (8½ x 11 inches).

The sheets of manuscript should be kept flat and fastened with clips which can be removed easily. The pages of the typewritten copy should be numbered consecutively in the upper right hand corner.

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Footnotes—Footnotes should be numbered from [1] up for each article. The first footnote for each article should begin with [1], a corresponding numeral appearing in the text. Footnotes should be separated from the text by lines across the bottom of the typewritten page. Sequence of information in a footnote is:

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(f) publisher,
(g) year,
(h) exact page reference.

Continued from December Quarterly

RESEARCH ABSTRACTS

Prepared by the Research Abstracts Committee of the Research Section, Carolyn W. Bookwalter, Chairman

Anatomy and Physiology

1. ASMUSSEN, E., AND M. NIELSEN. Efficacy of artificial respiration. *J. of Applied Physiology* **3**: 95–102 (1950).

The investigators studied the extent of lung ventilation during the three "leading" methods of manual artificial respiration—Schafer, Holger Nielsen, and Eve. Subjects were connected with Krogh metabolism apparatus and were allowed to breath normally. Thus the amount of tidal air was automatically recorded.

Artificial respiration was applied for one minute at a time. Since Nielsen and Eve methods consist of two phases, each phase was applied separately. The effect of Eve's method was further checked on subjects who became apneic after breathing pure oxygen.

Conclusion: Schafer prone method gave on the average 180 cc. of tidal air, and therefore pronounced as worthless (*sic!*). Nielsen method gave 450 cc. and Eve's, 540 and for this reason they are recommended as effective methods of artificial respiration. —*P. V. Karpovich.*

2. DUBRUL, E. LLOYD. Posture, locomotion and the skull in lagomorpha. *American Journal of Anatomy*, **87**: 2 (September, 1950).

An investigation directed toward uncovering the primary factors responsible for modification of the mammalian skull, confined to lagomorphs and rodents. Changes observed in these are similar to those observed in the primates. Previous studies have been confined to the primates where both drastic changes in posture, in locomotion, and progressive elaboration of the brain have confused the picture and resulted in conflicting opinions.

Compares postures and modes of locomotion of rat and hare. The alert rat assumes a slightly crouching position in which the long axis of its skull and the body axis approximate the same horizontal plane; the vertical column describes only minimal curves in the cervical and lumbar regions. The animal progresses by a scampering gait in which the center of gravity moves forward mainly in the horizontal plane with head and supporting axis extended in a relatively continuous line. In the hare in the alert position, the body axis deviates markedly from the horizontal; a sharp angle is formed by the body and the long axis of the skull. In gait, the center of gravity describes long arcs, forefeet striking the ground first, resulting in cervical lordosis to keep the head erect and away from the ground.

Survival for the hare is determined largely by alertness and speed in flight. Structure of the skull appears to be molded by this method of locomotion. Snout is bent downward, shortened and reduced in weight; eyes have migrated to the sides of the head; base of the skull is rotated upward and there is increased vaulting of the dorsum.

Study of rodents whose gaits are similar to the jack rabbit shows that the same changes are present. However study of brains of these animals shows no corresponding change; the greatest breadth of the cerebrum remains the same in all cases. Believes

that influences of posture upon skull form have been separated from those of advanced evolution of the brain in these animals; may indicate a law which would allow prediction of cranial modifications whenever posture and locomotion change from pronograde toward orthograde.—*Ruth Glassow.*

3. Smith, Raymond Dale. Qualitative observations on the post mortem shortening of muscles. *Anat. Rec.*, **108**: 2 (October, 1950).

The gastrocnemius muscles of rats were allowed to undergo rigor mortis in moist chambers and their length changes were recorded on a slow moving kymograph. As the rigor developed all of the muscles were observed to shorten. The maximal amount of shortening was maintained for only a few hours after which the muscles lengthened somewhat, but usually did not return to the original length. The shortening process was affected by the environmental temperature, proceeding very slowly at 0°C, more rapidly at room temperature (25°C), and most rapidly at 37°C. Muscles which had been previously subjected to tetanization shortened more quickly than non-tetanized muscles. The amount of shortening process is considered to be a very sensitive indicator of the post mortem chemical changes in muscle.—*The Wistar Institute.*

4. Smith, Raymond Dale. Studies on rigor mortis. Observations on the microscopic and submicroscopic structure. *Anat. Rec.*, **108**: 2 (October, 1950).

Studies were undertaken to follow step by step the changes taking place in the muscle after the death of the animal. Muscles were allowed to go into rigor and were fixed at various post mortem intervals. Paraffin sections (stained and unstained) were mounted in balsam and studied in ordinary and polarized light. The striations in the muscles are evident and relatively normal until putrefaction has resulted in complete destruction of the fiber (circa 48 hours). The birefringence of the muscles gradually diminishes, the peripheral fibers losing this property early, while in the more centrally located fibers it persists for a longer time. Areas of negative birefringent material appear showing some relationship to periodicity. In the extreme case fibers with negatively birefringent I bands alternating with weakly positive birefringent A bands are to be seen.—*The Wistar Institute.*

Athletics, Physical Education, and Recreation

5. How Good is Your School, The Phi Delta Kappan, **32**: 2 (December, 1950).

The first test by which an average citizen can tell how good his school is was presented in Life Magazine, October 16, 1950, and is condensed in the Phi Delta Kappan. Sixty three questions are asked and each yes answer is another indication of a good school.

The following questions apply particularly to the health and physical education program:

"45. At least 80 per cent of the classrooms have movable desks.
46. The building is inspected yearly by an official fire or building authority.
47. All the buildings are at least fire resistive.
48. Fire drills are held at frequent intervals. . . .
50. The washing facilities have hot running water.
51. There are flush toilets.
52. The school supplies soap in the school lavatories.
53. Students can obtain hot food at the school.
54. There is a yearly medical examination of every student requiring at least 30 minutes per pupil to perform.
55. The school provides inspection and cleaning of teeth by a dental hygienist at least once a year.
56. There is a high school football field.
57. There is a school gymnasium.
58. There is an organized intramural athletic program in the high school.
59. There is a club or hobby program.

60. At least 65 percent of the pupils participate in voluntary club or hobby programs. . . .
62. A cumulative record is maintained on each student and it goes with him on transferring to a different school."

—*John H. Shaw*

6. HUTCHINS, CLIFTON H. The use of school buildings for recreation. *Recreation*, 301–304, November, 1950.

The National Recreation Association conducted a survey of 105 communities in the United States as regards the use of school buildings by recreation departments. The study shows both the use and various restrictions of indoor school facilities in cities where year-round recreation departments conduct community programs in school buildings.—*Jack E. Hewitt.*

7. Research Division, N.E.A. Personnel and Relationships in School Health, Physical Education and Recreation. *Research Bulletin*, **28**: No. 3 (October, 1950). 111 pp.

Questionnaires were distributed to superintendents of schools in cities over 2500 in population. Twenty-three percent returned the questionnaires. Eight hundred twenty-five city school systems were represented in the returns.

The larger city systems have greater percentage enrolments in health and physical education in the elementary schools than do the smaller cities. The difference may be due to lack of facilities. Practically all high schools have some physical education facilities. Ninety-two percent of all pupils in school are enrolled in physical education classes. In high schools one out of ten are excused from physical education. In the smaller school systems the superintendent or some member of his staff perform the program direction for physical education. Physical education classes on the average are larger than academic classes. Fifty-eight percent of the larger city school systems and seventeen percent of the smaller schools have health councils. Current expenditures per pupil enrolled ranged from $10.51 in the smaller schools to $12.43 in the larger schools. Lack of adequate facilities was mentioned most as being a major obstacle to the health, physical education and recreation programs.—*Carolyn W. Bookwalter.*

8. THOMAS, E. A. Survey of track in high schools. *Athletic Journal*, **30**: 5 (January, 1950).

A compilation of the records made in the various state outdoor track meets during 1949. Records made in each state in 120 high hurdles, 100 yd. dash, mile, 880 relay, 440 yd. run, 200 yd. low hurdles, 880 yd. run, 220 yd. dash, pole vault, shot put, high jump, discus, broad jump, javelin. Compiled in chart form, indicates which break previous record for the state and which is the best national record for that year. On the basis of these 1949 records California ranks first; New York, second; Indiana, third; Illinois, fourth.

Gives records made in major relays in 1949—Texas, Drake, Penn, Kansas and Fresno. World record included for comparison.

Also has records from private and parochial schools for 1949 obtained by questionnaire.

This is the fourth of a nation-wide survey published annually by the Athletic Journal.—*Ruth Glassow.*

Education and Psychology

9. DYDYCHA, GEORGE J. The superstitious beliefs of college freshmen in 1930 and 1949. *School and Society*, 72, 1877: 376–379.

Ninety-six freshmen at Rippon College in 1929 were asked to indicate responses to thirty-five propositions that listed 25 popular superstitions. In September, 1930, eight hundred fifty-three freshmen in six midwestern colleges were given the same list. In 1949, two hundred sixty-six freshmen were given the same list. The same

procedures were used for all. A correlation of .85 ± .037 was found. A trend for more rejection of superstitions was found.—*Carolyn Bookwalter.*

10. Horst, Paul and Stevenson Smith. The discrimination of two racial samples. *Psychometrika*, **15**: 271–289 (September, 1950).

Fifty U. S. Army enlisted men of pure Japanese ancestry born in the Hawaiian Islands and fifty Caucasian enlisted men were involved in the study. Nineteen different anthropometric measures were obtained. The Price horizontal stadiometer was used for seven measurements, four measurements were made with wooden calipers, and three measurements were made with steel calipers.

Eleven variables showed differences significant at the one percent level of confidence and were further investigated. A method was devised to take the place of the Wherry-Doolittle method. This devised method was found to be faster than any other method known by the authors and also to give a good approximation to the multiple correlation, if desired, at each step with very little additional computation. The mathematical derivation fot the procedure is given.—*Carolyn Bookwalter.*

11. Slobetz, F. Discipline. *The Phi Delta Kappan*, **32**: 3 (November, 1950).

In a study of how 290 elementary teachers recommended by their administrators as belonging to the more competent group met selected school situations Mr. Slobetz found constructive assistance and verbal appeal were used most frequently to meet pupil problem situations.

The following summary shows totals of method used:

Method	*Frequency, %*	
Physical Force	1	
Censure	10	
Overtime or extra work	4	
Deprivation	10	
Sent or referred to office	1	
Rectification or reparation	2	
Ignored or verbal appeal	26	
Group reaction—constructive assistance	31	
Commendation	1	
Searched for reasons for behavior	6	
Tried many things unsuccessfully	0.3	
Total number of reports on situations met	(99.9)	10244

—*John Shaw.*

Health and Nutrition

12. Anderson R. J. and Palmer, C. E. BCG. *J. School Health*, **20**: 9 (November, 1950).

A critical analysis of BCG programs. The authors contend that such programs are not based on any recent demonstration of the vaccine's value in the prevention of tuberculosis and therefore should be viewed with skepticism. Potency of BCG is quite variable and the life of the vaccine is a matter of conjecture with recommendations of producers varying from five to fourteen days.

Evidence shows that little is known as to what the appropriate tuberculin criteria are for selecting persons for vaccination. Furthermore the authors indicate considerable question as to the duration of immunity. Apparently the degree of allergy produced can wane rapidly.

In two countries where BCG vaccination has been carried on for many years there is no scientifically reliable data obtainable as to how it has affected the history of tuberculosis in the country as a whole. In Iceland the death rate from tuberculosis fell from 200 per 100,000 to 70 in a period of 15 years and in 1948 had fallen to 34, without the use of BCG.

The conclusion reached was that currently accepted methods of tuberculosis control should be continued vigorously in all areas rather than to substitute BCG vaccination. Mass vaccination programs are warranted only for carefully documented evaluation studies. Otherwise the most that can be suggested at this time is its use in selected groups in which known exposure exists.—*John Shaw.*

13. Chitre, Raghunath Ganesh, Jesse Noah Williams, and Conrad Arnold Elvehjem. Nutritive value of canned foods. *J. Nutrition*, **42**: 2 (October, 1950).

A study of the biological value of the protein in immature and nearly mature peas has been made. The effects of canning on the biological value of the protein in peas have also been investigated. It appears that canning does not decrease the biological value of nearly mature peas while it enhances that of immature peas. Investigations concerning the cause of poor biological value of immature raw peas suggest that hydrolysis of the protein and subsequent deamination of the amino acids occur through enzymatic action when the peas are moistened. The possibility is discussed that reactions during the drying process between the sugar in the raw peas and the amino acids freed by proteolysis contribute to the decrease in the biological value of raw peas for the rat.—*The Wistar Institute.*

14. Csonka, Frank A. Nitrogen, methionine and cystine content of hen's eggs. Their distribution in the egg white and yolk. *J. Nutrition*, **42**: 3 (November, 1950).

Eggs of pullets in their first year laying period were analyzed. As pullets aged and were fed a low protein diet, the nitrogen quantity decreased in the egg white and increased in the yolk; with the pullets fed a high protein diet the nitrogen increased in both. The cystine and methionine content of the white and the yolk of the eggs generally paralleled the changes in nitrogen values. However, the cystine/methionine ratio in the egg white decreases with the age of the pullet, regardless of the diets employed. An increased ratio in the yolk resulting from aging was found to be statistically significant only during the low-protein dietary regimen. Enzymatically digested casein in the hen's feed increases the cystine and methionine content of the egg to the same extent as does casein.—*The Wistar Institute.*

15. Deuel, Harry James, Jr., Samuel Mendel Greenberg, Evelyn Elizabeth Savage, and Lucien A. Bavetta. Studies on the comparative nutritive values of fats. *J. Nutrition*, **42**: 2 (October, 1950).

Rats were maintained on a diet in which a hydrogenated vegetable margarine fat replaced butterfat in Sherman diet B for a period of 25 generations. Growth rates, fertility and lactation were used as indices of nutritional value and these were at the same high level as was reported earlier for the first ten generations. Somewhat better growth and lactation were obtained in a "second litter" series started with the fifteenth and continued through the twenty-first generation than with the "first litter" series. In an experiment in which a group of animals were maintained on the modified Sherman diet, and others on the regular Sherman diet, no significant differences in growth reproduction and lactation were observed, irrespective of whether the previous nutritional history of mothers involved a stock diet or the modified Sherman diet over twenty previous generations. The calcium content of the whole carcasses of 21-day-old rats was higher in animals whose mothers had received a modified Sherman diet than in those where the previous maternal diet had been the usual Sherman diet. Calcium balances on the rats at 90 days of age showed a more favorable positive balance for the rats on the hydrogenated vegetable margarine than for those on the original Sherman diet.—*The Wistar Institute.*

16. Greenberg, Samuel Mendel and Harry James Deuel, Jr. The protective effect of high fat diets on immature rats fed thyroid. *J. Nutrition*, **42**: 2 (October, 1950).

A retardation of growth in immature rats fed a fat-low diet lacking in essential fatty acids which was accentuated by the administration of relatively low dosages

of desiccated thyroid. The feeding of this hormone also significantly reduced the average length of survival of rats on a diet deficient in fat. No such deleterious effects occurred when a similar diet containing 30 percent of cottonseed oil was given.—*The Wistar Institute.*

17. JOHNSTON, FRANCES ANN, THELMA MCMILLAN, AND ERICA R. EVANS. Perspiration as a factor influencing the requirement for calcium and iron. *J. Nutrition*, **42**: 2 (October, 1950).

Perspiration was collected from four young women, each of whom served as a subject for four periods of approximately an hour each. The temperatures used were 97°F dry bulb and 93°F wet bulb. The collection was made in enamel tubs in which the subjects sat during the sweating period. Perspiration from all parts of the body except the scalp were collected. The mean loss of body-weight per hour during the collection periods was 10.87 oz. (308 gm.). The mean loss of iron per kilogram of body-weight loss for each of the four subjects was 13.42, 30.42, 32.52, and 40.10 mg.; the mean loss per hour was 4.17, 6.80, 8.84, and 14.33 mg. The administration of 25 mg. of iron with breakfast on the day of the collection did not increase the loss of iron, nor did a subject who was taking iron therapy daily secrete more iron than the other subjects. —*The Wistar Institute.*

18. TODHUNTER, ELIZABETH NEIGE, THELMA MCMILLAN, AND DOROTHY A. EHMKE. Utilization of dehydroascorbic acid by human subjects. *J. Nutrition*, **42**: 2 (October, 1950).

Seven women between 20 and 30 years of age served as subjects in an experiment designed to ascertain the availability of dehydroascorbic acid as a source of vitamin C. In the preliminary stabilization period subjects received 75 mg. of ascorbic acid for seven days. In the control period of five days a vitamin-C-low basal diet was supplemented with 65 mg. ascorbic acid in the form of orange juice followed immediately by the test period when norit-treated orange juice containing 65 mg. dehydroascorbic acid was given for five days. The experiment was repeated again for each subject with the order of the control and test periods reversed.

Blood and urine were analyzed daily for reduced ascorbic acid by the indophenol method and for total ascorbic acid by the phenylhydrazine method; readings were made in a Coleman spectrophotometer. The levels of reduced ascorbic acid in blood and urine were comparable in the control and test periods for the majority of subjects indicating that dehydroascorbic acid is readily converted to the reduced form and is well utilized by human subjects.—*The Wistar Institute.*

19. BLAKE, J. Pregnancy with tuberculosis—management and prognosis. N. Y. State J. of Med., **50**: 21 (Nov. 1, 1950).

In a series of 100 cases of tuberculosis with pregnancy, observed over a 15 year period there were four deaths. The cases studied covered all stages of tuberculosis. It was concluded that "pregnancy and tuberculosis are not incompatible." In cases of active tuberculosis, the pregnant woman needs special medical care, but a normal child can be expected, and the course of the disease in the mother will probably "continue its normal course."

Pregnancy does not "necessarily have any deleterious effect upon tuberculosis of the lung," nor should a pregnancy be interrupted because the patient has tuberculosis. Routine chest X-rays are recommended as a "must" in the obstetrical examination of every pregnant woman.—*A. C. Kelly.*

20. RABINER A. Concerning neurologic complications following spinal anesthesia. N. Y. State J. of Med., **50**: 21 (Nov. 1, 1950).

A series of 6 case studies in which spinal anesthesia was used revealed that this ethod of anesthesia is not to be considered harmless. The investigator concludes that although there are cases of cranial nerve and cerebral involvement, "careful attention to technic of the spinal puncture should lessen such occurrences."—*A. C. Kelly.*

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